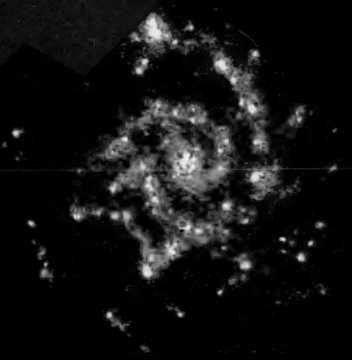
Scientific and Technical Aerospace Reports

STAR



An Abstract Journal

Volume 30, Number 16
August 23, 1992
N92-25146 to N92-26170

Scientific and Technical Aerospace Reports

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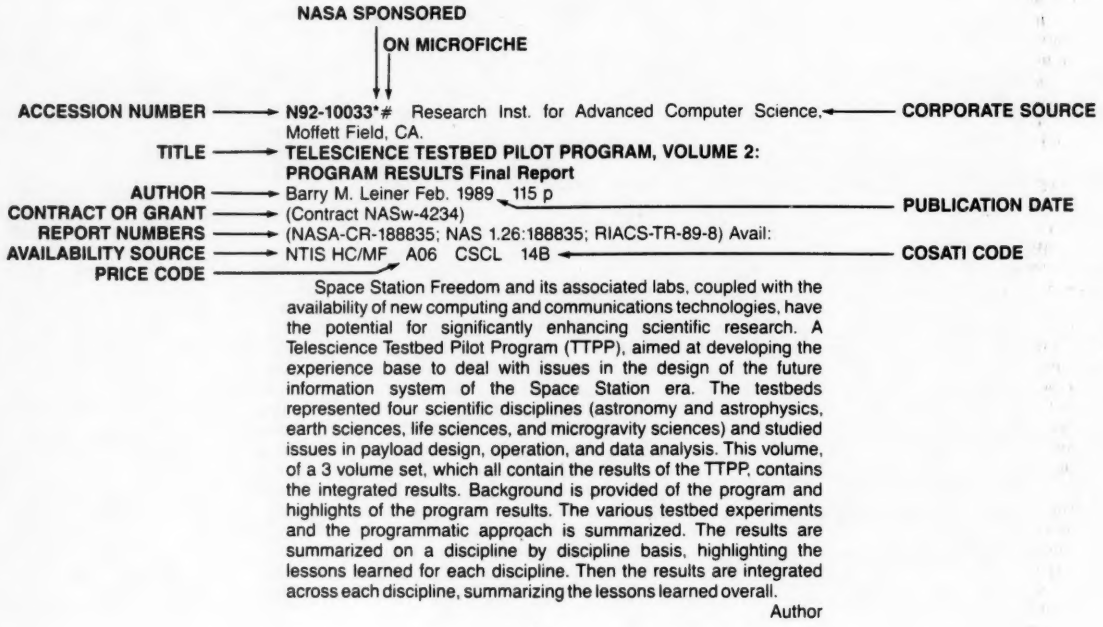
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ACCESSION NUMBER
N92-10033*# Research Inst. for Advanced Computer Science,
CORPORATE SOURCE
Moffett Field, CA.
TITLE
TELESCIENCE TESTBED PILOT PROGRAM, VOLUME 2:
PROGRAM RESULTS Final Report
AUTHOR
Barry M. Leiner Feb. 1989 115 p
PUBLICATION DATE
CONTRACT OR GRANT
(Contract NASw-4234)
REPORT NUMBERS
(NASA-CR-188835; NAS 1.26:188835; RIACS-TR-89-8) Avail:
AVAILABILITY SOURCE
NTIS HC/MF A06 CSCL 14B
COSATI CODE
PRICE CODE
Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.
Author

VOLUME 30 NUMBER 16 / AUGUST 23, 1992

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

No abstracts in this category.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-25175*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

AN ANALYTICAL APPROACH TO GRID SENSITIVITY ANALYSIS FOR NACA FOUR-DIGIT WING SECTIONS

Progress Report, 1 Jan. - 31 Dec. 1991

I. Sadrehaghighi and S. N. Tiwari Apr. 1992 69 p

(Contract NCC1-68)

(NASA-CR-190251; NAS 1.26:190251) Avail: NTIS HC/MF A04

Sensitivity analysis in computational fluid dynamics with emphasis on grids and surface parameterization is described. An interactive algebraic grid-generation technique is employed to generate C-type grids around NACA four-digit wing sections. An analytical procedure is developed for calculating grid sensitivity with respect to design parameters of a wing section. A comparison of the sensitivity with that obtained using a finite difference approach is made. Grid sensitivity with respect to grid parameters, such as grid-stretching coefficients, are also investigated. Using the resultant grid sensitivity, aerodynamic sensitivity is obtained using the compressible two-dimensional thin-layer Navier-Stokes equations. Author

N92-25202*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THE NATURAL FLOW WING-DESIGN CONCEPT

Richard M. Wood and Steven X. S. Bauer May 1992 44 p

Previously announced in IAA as A89-49677

(NASA-TP-3193; L-16837; NAS 1.60:3193) Avail: NTIS HC/MF A03

A wing-design study was conducted on a 65 degree swept leading-edge delta wing in which the wing geometry was modified to take advantage of the naturally occurring flow that forms over a slender wing in a supersonic flow field. Three-dimensional nonlinear analysis methods were used in the study which was divided into three parts: preliminary design, initial design, and final design. In the preliminary design, the wing planform, the design conditions, and the near-conical wing-design concept were derived, and a baseline standard wing (conventional airfoil distribution) and a baseline near-conical wing were chosen. During the initial analysis, a full-potential flow solver was employed to determine the aerodynamic characteristics of the baseline standard delta wing and to investigate modifications to the airfoil thickness, leading-edge radius, airfoil maximum-thickness position, and wing upper to lower surface asymmetry on the baseline near-conical wing. The final design employed an Euler solver to analyze the best wing configurations found in the initial design and to extend the study of wing asymmetry to develop a more refined wing. Benefits resulting from each modification are discussed, and a final 'natural flow' wing geometry was designed that provides an improvement in aerodynamic performance compared with that of a baseline conventional uncambered wing, linear-theory cambered wing, and near-conical wing. Author

N92-25261*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ASSESSMENT OF POTENTIAL AERODYNAMIC BENEFITS FROM SPANWISE BLOWING AT THE WING TIP Ph.D. Thesis - George Washington Univ.

Raymond Edward Mineck May 1992 359 p

(NASA-TM-107847; NAS 1.15:107847) Avail: NTIS HC/MF A16

A comprehensive set of experimental and analytical investigations have been conducted to assess the potential aerodynamic benefits from spanwise blowing at the tip of a moderate aspect ratio, swept wing. An analytical model has been developed to simulate a jet exhausting from the wing tip. An experimental study of a subsonic jet exhausting from the wing tip was conducted to investigate the effect of spanwise blowing from the tip on the aerodynamic characteristics of a moderate aspect ratio, swept wing. Wing force and moment data and surface pressure data were measured at Mach numbers up to 0.72. Results indicate that small amounts of blowing from small jets increase the lift curve slope a small amount, but have no effect on drag. Larger amounts of blowing from longer jets blowing increases lift near the tip and reduce drag at low Mach numbers. These benefits decrease with increasing Mach number, and vanish at Mach 0.5. A Navier-Stokes solver with modified boundary conditions at the tip was used to extrapolate the results to a Mach number of 0.72. With current technology and conventional wing shapes, spanwise blowing at the wing tip does not appear to be a practical means of reducing drag of moderate aspect ratio wings at high subsonic Mach numbers. Author

N92-25276*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

WIND-TUNNEL STATIC AND FREE-FLIGHT INVESTIGATION OF HIGH-ANGLE-OF-ATTACK STABILITY AND CONTROL CHARACTERISTICS OF A MODEL OF THE EA-6B AIRPLANE

Frank L. Jordan, Jr. and David E. Hahne May 1992 60 p

(NASA-TP-3194; L-16813; NAS 1.60:3194) Avail: NTIS HC/MF A04

An investigation was conducted in the Langley 30- by 60-Foot Tunnel and the Langley 12-Foot Low-Speed Tunnel to identify factors contributing to a directional divergence at high angles of attack for the EA-6B airplane. The study consisted of static wind-tunnel tests, smoke and tuft flow-visualization tests, and free-flight tests of a 1/8.5-scale model of the airplane. The results of the investigation indicate that the directional divergence of the airplane is brought about by a loss of directional stability and effective dihedral at high angles of attack. Several modifications were tested that significantly alleviate the stability problem. The results of the free-flight study show that the modified configuration exhibits good dynamic stability characteristics and could be flown at angles of attack significantly higher than those of the unmodified configuration. Author

N92-25279*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN ENGINEERING METHOD FOR INTERACTIVE INVISCID-BOUNDARY LAYERS IN THREE-DIMENSIONAL HYPERSONIC FLOWS Ph.D. Thesis - North Carolina State Univ., Raleigh
Christopher J. Riley 1992 138 p
(NASA-TM-107838; NAS 1.15:107838) Avail: NTIS HC/MF A07

An engineering method has been developed that couples an approximate three dimensional inviscid technique with the axisymmetric analog and a set of approximate convective heating equations. The displacement effect on the boundary layer on the outer inviscid flow is calculated and included as a boundary condition in the inviscid technique. This accounts for the viscous interaction present at lower Reynolds numbers. The method is applied to blunted axisymmetric and three dimensional elliptic cones at angle of attack for the laminar hypersonic flow of a perfect gas. The method is applied to turbulent and equilibrium-air conditions. The present technique predicts surface heating rates, pressures, and shock shapes that compare favorably with experimental (ground-test and flight) data and numerical solutions of the Navier-Stokes and viscous shock-layer equations. In addition, the inclusion of viscous interaction significantly improves results obtained at lower Reynolds numbers. The new technique represents a major improvement over current engineering aerothermal methods with only a modest increase in computational effort. Author

N92-25366# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.
STATIC AEROELASTIC ANALYSIS OF ACT WIND TUNNEL MODEL AIRCRAFT [ZENKI ACT FUSHI MOKEI NO SEITEKI KURIKI DANSEI KAISEKI]
Hiroshi Matsushita, Kenji Fujii, Tetsuhiko Ueda, and Mitsunori Yanagisawa Jul. 1990 17 p In JAPANESE Original contains color illustrations
(NAL-TM-624; ISSN-0452-2982; JTN-92-80312) Avail: NTIS HC/MF A03

As a part of research activities on ACT (Active Control Technology) at NAL, wind tunnel tests on the ACT wind tunnel model aircraft with elastic wings were performed to investigate the effect of rigid body movement mode to gust load alleviation effects. The mathematical model of the ACT wind tunnel model aircraft was to be constructed to design the control rule of gust load alleviation. Accordingly, the related data were to be obtained by vibration tests and by wind tunnel tests. The mathematical model was to be examined using an analytical method. In the beginning, the structural analysis model using Finite Element Method (FEM) was constructed based on the measurement results of rigidity distribution, mass distribution, and inertia moment distribution. The mathematical model on structural characteristics was derived with the adjustment of the structure parameters obtained from vibration tests. The static deformation analysis method is the mathematical model obtained by the combination of the the aerodynamic analysis software. The data obtained from the static aerodynamic elasticity analysis is compared with the wind tunnel test results. The inclusion of elastic effects was found to improve the correlation of analysis results with the wind tunnel test results. Details of the analysis results are reported.
Author (NASDA)

N92-25410 Aeronautical Research Labs., Melbourne (Australia).
VISUALISATION IN WATER OF VORTEX FLOW OVER SHARP-EDGED CANARD CONFIGURATIONS
D. H. Thompson Apr. 1992 62 p
(ARL-Flight-Mech-R-189; AR-006-587) Copyright Avail: Issuing Activity

A wing/canard configuration with sharp, highly swept leading edges was tested in a small towing tank. Flow visualization techniques were used to study the effects of canard position on vortex interactions and vortex breakdown. A canard above or co-planar with the wing delayed wing vortex breakdown. A canard below the wing produced a strong interaction between the wing and canard vortices and could cause early wing vortex breakdown. Depending on its longitudinal position, the low canard could seriously disrupt the wing flow. Author

N92-25477# Associated Scientists at Woods Hole, Inc., MA.
AIRSHIPS FOR MARINE MAMMAL RESEARCH: EVALUATION AND RECOMMENDATIONS Final Report
J. H. W. Hain 18 Jun. 1991 38 p
(Contract MMC-T68108863)
(PB92-128271) Avail: NTIS HC/MF A03

The report describes an investigation of how existing and next generation airships might be used in marine mammal research. Sixteen flights, resulting in 65 hours and 1400 miles of surveys were made under various weather conditions. A great deal about the operation and potential of airships for prolonged observations of marine mammals was learned. The airship provides capabilities for slow speed surveys with stability, a roomy cabin, and a demonstrated ability to fly accurate survey lines. It has the advantage of being able to stop, make observations, or 'pace along' with a swimming whale, for instance. In the case of marine mammal studies, the airship, despite the constraints associated with it, provides a highly desirable research platform for ocean observations. Author

N92-25510*# Vigyan Research Associates, Inc., Hampton, VA.
A LOW-SPEED WIND TUNNEL STUDY OF VORTEX INTERACTION CONTROL TECHNIQUES ON A CHINE-FOREBODY/DELTA-WING CONFIGURATION
Dhanvada M. Rao and M. K. Bhat Mar. 1992 39 p
(Contract NAS1-18856)
(NASA-CR-189616; NAS 1.26:189616) Avail: NTIS HC/MF A03

A low speed wind tunnel evaluation was conducted of passive and active techniques proposed as a means to impede the interaction of forebody chine and delta wing vortices, when such interaction leads to undesirable aerodynamic characteristics particularly in the post stall regime. The passive method was based on physically disconnecting the chine/wing junction; the active technique employed deflection of inboard leading edge flaps. In either case, the intent was to forcibly shed the chine vortices before they encountered the downwash of wing vortices. Flow visualizations, wing pressures, and six component force/moment measurements confirmed the benefits of forced vortex de-coupling at post stall angles of attack and in sideslip, viz., alleviation of post stall zero beta asymmetry, lateral instability and twin tail buffet, with insignificant loss of maximum lift. Author

N92-25569 Florida Univ., Gainesville.
ON A MULTI-BLOCK METHOD FOR TRANSONIC TURBULENT FLOWS PAST A WING-FUSELAGE CONFIGURATION Ph.D. Thesis
Chau-Lin Lee 1991 109 p
Avail: Univ. Microfilms Order No. DA9209040

A multi-block method being explored is further developed and investigated for the simulation of Mach 0.8 transonic turbulent flow past a wing-fuselage configuration at - 3.0 degree angle of attack. In this method, the flow field of interest is first divided into six contiguous blocks in such a way that each block is partially bounded by a solid surface. Accordingly, the solid surface is mapped onto a complete rectangular boundary plane in the computational domain for effective calculation of algebraic eddy viscosity as well as for direct application of a thin-layer Navier-Stokes code. Then, in the solution process, each block is treated as an independent flow problem, modeled by unsteady Reynolds-averaged thin-layer Navier-Stokes equations, with the interface boundary conditions updated at every time step. The employed turbulence closure model is the Baldwin-Lomax eddy viscosity model. The multi-block method being investigated has a distinct advantage in design application in that a local change to the configuration requires only the related block grid to be regenerated. However, the excessive distortion on block domain transformation, in particular the wing blocks, imposed by the special features of the method makes it difficult to generate good block

grids for accurate flow simulation. Accordingly, special measures and proper techniques for quality block griddings have to be developed and investigated. Dissert. Abstr.

N92-25752*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MEASUREMENTS OF FLUCTUATING PRESSURE IN A RECTANGULAR CAVITY IN TRANSONIC FLOW AT HIGH REYNOLDS NUMBERS
M. B. Tracy, E. B. Plentovich, and Julio Chu Jun. 1992 32 p
(NASA-TM-4363; L-16859; NAS 1.15:4363) Avail: NTIS HC/MF A03

An experiment was performed in the Langley 0.3 meter Transonic Cryogenic Tunnel to study the internal acoustic field generated by rectangular cavities in transonic and subsonic flows and to determine the effect of Reynolds number and angle of yaw on the field. The cavity was 11.25 in. long and 2.50 in. wide. The cavity depth was varied to obtain length-to-height (l/h) ratios of 4.40, 6.70, 12.67, and 20.00. Data were obtained for a free stream Mach number range from 0.20 to 0.90, a Reynolds number range from 2 x 10(exp 6) to 100 x 10(exp 6) per foot with a nearly constant boundary layer thickness, and for two angles of yaw of 0 and 15 degs. Results show that Reynolds number has little effect on the acoustic field in rectangular cavities at angle of yaw of 0 deg. Cavities with l/h = 4.40 and 6.70 generated tones at transonic speeds, whereas those with l/h = 20.00 did not. This trend agrees with data obtained previously at supersonic speeds. As Mach number decreased, the amplitude, and bandwidth of the tones changed. No tones appeared for Mach number = 0.20. For a cavity with l/h = 12.67, tones appeared at Mach number = 0.60, indicating a possible change in flow field type. Changes in acoustic spectra with angle of yaw varied with Reynolds number, Mach number, l/h ratios, and acoustic mode number. Author

N92-25959*# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
FINITE ELEMENT METHODS FOR INTEGRATED AERODYNAMIC HEATING ANALYSIS Report, 1 Oct. 1990 - 30 Sep. 1991
K. Morgan and J. Peraire 1991 22 p
(Grant NAGw-1809)
(NASA-CR-190353; NAS 1.26:190353) Avail: NTIS HC/MF A03

This report gives a description of the work which has been undertaken during the second year of a three year research program. The objectives of the program are to produce finite element based procedures for the solution of the large scale practical problems which are of interest to the Aerothermal Loads Branch (ALB) at NASA Langley Research Establishment. The problems of interest range from Euler simulations of full three dimensional vehicle configurations to local analyses of three dimensional viscous laminar flow. Adaptive meshes produced for both steady state and transient problems are to be considered. An important feature of the work is the provision of specialized techniques which can be used at ALB for the development of an integrated fluid/thermal/structural modeling capability. H.A.

N92-25967*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A STATIC INVESTIGATION OF THE THRUST VECTORING SYSTEM OF THE F/A-18 HIGH-ALPHA RESEARCH VEHICLE
Mary L. Mason, Francis J. Capone, and Scott C. Asbury Washington Jun. 1992 165 p
(NASA-TM-4359; L-17002; NAS 1.15:4359) Avail: NTIS HC/MF A08

A static (wind-off) test was conducted in the static test facility of the Langley 16-foot Transonic Tunnel to evaluate the vectoring capability and isolated nozzle performance of the proposed thrust vectoring system of the F/A-18 high alpha research vehicle (HARV). The thrust vectoring system consisted of three asymmetrically spaced vanes installed externally on a single test nozzle. Two nozzle configurations were tested: A maximum afterburner-power nozzle and a military-power nozzle. Vane size and vane actuation geometry were investigated, and an extensive matrix of vane deflection angles was tested. The nozzle pressure ratios ranged from two to six. The results indicate that the three vane system can successfully generate multiaxis (pitch and yaw) thrust vectoring. However, large resultant vector angles incurred large thrust losses. Resultant vector angles were always lower than the vane deflection angles. The maximum thrust vectoring angles achieved for the military-power nozzle were larger than the angles achieved for the maximum afterburner-power nozzle. Author

N92-26104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARISON OF PREDICTED AND MEASURED INLET DISTORTION FLOWS IN A SUBSONIC AXIAL INLET FLOW COMPRESSOR ROTOR
Albert K. Owen Mar. 1992 198 p Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-105427; E-6843; AVSCOM-TR-92-C-001; NAS 1.15:105427) Avail: NTIS HC/MF A09

Detailed flow measurements were taken inside an isolated axial compressor rotor operating subsonically near peak efficiency. These Laser Anemometer measurements were made with two inlet velocity profiles. One profile consisted of an unmodified baseline flow, and the second profile was distorted by placing axisymmetric screens on the hub and shroud well upstream of the rotor. A detailed comparison in the rotor relative reference frame between a Navier-Stokes solver and the measured experimental results showed good agreement between the predicted and measured flows. A primary flow is defined in the rotor and deviations and the computed predictions is made to assess the development of a passage vortex due to the distortion of the inlet flow. Computer predictions indicate that a distorted inlet profile has a minimal effect on the development of the flow in the rotor passage and the resulting passage vortex. Author

N92-25713*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GRID MANAGEMENT
Danny Hwang *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 3-15 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25723*# Ohio State Univ., Columbus.
GRID GENERATION RESEARCH AT OSU Abstract Only
S. Nakamura *In* NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas Apr. 1992 p 121 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25814*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A NEW LAGRANGIAN METHOD FOR REAL GASES AT SUPERSONIC SPEED
C. Y. Loh and Meng-Sing Liou *In its* Computational Fluid Dynamics Feb. 1992 p 75-81 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-25262 RAND Corp., Santa Monica, CA.
TILT ROTORS AND THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY AIRPORT SYSTEM Executive Summary
Jerome Aroesty, David Rubenson, and Geoffrey Gosling 1992 19 p Prepared for Port Authority of New York and New Jersey,

Jersey City
(RAND-R-3971/1-PA-Summ; ISBN-0-8330-1193-6) Avail: NTIS HC/MF A03

Examined here are the market, infrastructure, technology, and policy requirements for sustained commercial tilt-rotor service between the Port Authority of New York and New Jersey (PANYNJ) aviation service area and other cities in the high-volume short-haul market. The study seeks to add a degree of realism to earlier studies by incorporating potential passenger reactions to an innovative vehicle that to many people evokes an association with helicopters. The primary objective is to examine the feasibility, benefits, and drawbacks of using the major Port Authority airports to support tilt-rotor service to high volume destinations currently served by turboprop aircraft operated by regional airlines. Also examined is an airport-based tilt-rotor system between PANYNJ airports and Washington and Boston. These cities are significant because they account for 40 percent of short-haul passenger traffic at PANYNJ airports, and could potentially support commercial tilt-rotor service even at moderate or low tilt-rotor market share.
Author

N92-25297# Federal Aviation Administration, Washington, DC.
AVIATION SYSTEM: CAPITAL INVESTMENT PLAN
Dec. 1991 342 p
Avail: NTIS HC/MF A15

The Federal Aviation Administration's (FAA) second annual Aviation System Capital Investment Plan (CIP) is presented. The plan describes the facilities and equipment programs that the FAA will pursue in addressing key concerns of the National Aerospace system (NAS), such as safety, efficiency, traffic demands, equipment and facilities, and airspace use. The CIP creates a plan for the evolution of the existing NAS through the use of new technologies and the development of new products obtained from continuing research. Specific topics covered include a system description; requirements that expand, relocate, or consolidate existing facilities/equipment; projects that refurbish structures, replace obsolete equipment, or relocate facilities to maintain service, improve effectiveness, or reduce cost; and projects that support logistics, provide for personnel training, and manage the information and human resource aspects of NAS modernization.
Author

N92-25350# Survival Systems Ltd. (Alberta).
A REPORT ON ENHANCEMENTS FOR EXISTING AND FUTURE HELICOPTERS SUPPORTING OPERATIONS OF THE CANADIAN OIL AND GAS INDUSTRY
15 Jun. 1989 189 p Prepared for Canadian Petroleum Association, Calgary, Alberta
(CTN-91-60126) Copyright Avail: NTIS HC/MF A09

A study of safety enhancements pertaining to the safe operation of helicopters in support of oil exploration is presented. These topics include structures, seats, restraint harnesses, fuel and fuel systems, overwater operational systems, wire warning devices and flight data recorders. Under each topic related accidents are analyzed, developments and research are outlined, available equipment is reviewed, and recommendations are made regarding research and regulation. The main conclusions and recommendations are as follows: the use of shoulder restraint harnesses should be mandated and existing helicopters should be retrofitted; the use of crashworthy fuel systems would significantly reduce thermal injuries and should be considered when purchasing a helicopter; overwater operations should consider use of externally mounted liferafts, immersion suits, and automatic deployment systems; improved energy absorbing fuselages, landing gear, and seats should be considered on new acquisitions; wire warning devices should be used on operations requiring low level flying; consultation with regulatory agencies on the requirements for flight data recorders should be undertaken. A bibliography and an annex of manufacturere's promotional literature on the topic are included.
CISTI

N92-26028# Systems Control Technology, Inc., Arlington, VA.
ANALYSIS OF HELICOPTER ACCIDENT RISK EXPOSURE NEAR HELIPORTS, AIRPORTS, AND UNIMPROVED SITES
Final Report
R. J. Adams, E. D. McConkey, L. D. Dzamba, and R. D. Smith (Federal Aviation Administration, Washington, DC.) Feb. 1992 68 p
(Contract DTFA01-87-C-00014)
(SCT-91RR-13; DOT/FAA/RD-90/9) Avail: NTIS HC/MF A04

The development of relevant safety indicators to be used in the assessment of risk exposure due to heliport design and operational standards is discussed. Since helicopter accidents have been relatively rare events, historical data at heliports are somewhat limited. Therefore, the approach described herein is to develop the total helicopter risk exposure due to all causes and then estimate what proportion of that risk should be allocated to various circumstances associated with specific heliport design and helicopter operational characteristics. This approach introduces the need for analysis and quantification of risk using a parameter or parameters that both industry and government agree are within a logical framework. Data on the number of helicopter accidents per year, accidents per 100,000 hours of flight time, accidents per 100,000 mission segments, accident rates for selected mission types, occupant risk of serious injury, and neighborhood risk are presented. Finally, civil helicopter accidents are categorized by the facilities near which they occur (heliport, airport, etc.) and by the operating facility design parameters that impact operational risk.
Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-25470# Sandia National Labs., Albuquerque, NM.
EVALUATING THE VELOCITY ACCURACY OF AN INTEGRATED GPS/INS SYSTEM: FLIGHT TEST RESULTS
T. E. Owen and R. Wardlaw 1991 11 p Presented at the Institute of Navigation National Technical Meeting, San Diego, CA, 27-29 Jan. 1992
(Contract DE-AC04-76DP-00789)
(DE92-007519; SAND-91-2584C; CONF-920187-1) Avail: NTIS HC/MF A03

Verifying the velocity accuracy of a GPS receiver or an integrated GPS/INS system in a dynamic environment is a difficult proposition when many of the commonly used reference systems have velocity uncertainties of the same order of magnitude or greater than the GPS system. The results of flight tests aboard an aircraft in which multiple reference systems simultaneously collected data to evaluate the accuracy of an integrated GPS/INS system are reported. Emphasis is placed on obtaining high accuracy estimates of the velocity error of the integrated system in order to verify that velocity accuracy is maintained during both linear and circular trajectories. Three different reference systems operating in parallel during flight tests are used to independently determine the position and velocity of an aircraft in flight. They are a transponder/interrogator ranging system, a laser tracker, and GPS carrier phase processing. Results obtained from these reference systems are compared against each other and against an integrated real time differential based GPS/INS system to arrive at a set of conclusions about the accuracy of the integrated system.
DOE

N92-25518# Federal Aviation Administration, Washington, DC.
GENERAL MAINTENANCE HANDBOOK FOR AIRWAY FACILITIES

15 Aug. 1991 114 p
(PB92-147586) Avail: NTIS HC/MF A06

The document discusses the Airway Facilities Maintenance Program. General administrative and management standards, procedures, and guidelines are provided for the operational maintenance of the National Airspace System (NAS) facilities and equipment. GRA

N92-25590# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
FLIGHT TEST OF AVIONIC AND AIR-TRAFFIC CONTROL SYSTEMS
Jul. 1991 262 p In GERMAN; ENGLISH summary Presented at Scientific Seminar, Brunswick, Fed. Republic of Germany, 4-5 Jun. 1991 Report will also be announced as translation (ESA-TT-1279)
(ETN-92-91063) Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

DLR aircraft and their basic measuring equipment are described. The possibilities of telemetric ground equipment for the preparation and evaluation of flight tests are described. The experimental cockpit Advanced Technologies Testing Aircraft System (ATTAS) and the Air Traffic Management and Operations Simulator (ATMOS) are presented. An experimental flight management system and the concept of a movement area guidance were tested. Concept, realization, and applications of a helicopter experimental platform are presented. A fault tolerant fly-by-light yaw control system was presented. The avionics flight evaluation system (AFES) is described. A board-autonomous flight trajectory measuring technique is presented. An experimental photoreconnaissance system is described. For individual titles, see N92-25591 through N92-25603.

N92-25591# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Flugabteilung.
THE DLR TEST AIRCRAFT IN FZ-BS VFW614/ATTAS, DORNIER DO228-101, MBB BO 105-S-3 [DIE DLR-VERSUCHSLUFTFAHRZEUGE IM FZ-BS, -VFW 614/ATTAS, DORNIER DO 228-101, MBB BO105 S-3] **c05**
Hans-L. Meyer *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 9-34 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The different test aircraft used by DLR are described. The Dornier DO-228-101 is an all metal airplane with mid set wings and two turboprop engines. The fuselage has a rectangular cross section and is not pressurized. The reference flight trajectory can be very accurately measured with a view to the control of navigation and landing systems. The flying helicopter simulator BO-105 S-3 is highly maneuverable and contains controllable main and tail rotors. The flying simulator, ATTAS (Advanced Technologies Testing Aicraft Systems), was developed starting from a short range jet, the VFW 614, such that flight trajectories and maneuvers of other models can be tested and checked under flight conditions. ESA

N92-25592# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
THE BASIC MEASURING TECHNICAL EQUIPMENT OF THE DLR TEST AIRCRAFT [DIE MESSTECHNISCHE GRUNDAUSRUESTUNG DER DLR-VERSUCHSFLUGZEUGE] **c06**
Helmut Bothe *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 35-48 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The measuring equipment systems of the ATTAS (Advanced Technologies Testing Aircraft Systems) and the DO 228 are described. The main aim of the basic equipment is to determine the necessary parameters, and to filter, prepare, adapt, and process the signals, via a comprensive sensor system. The basic equipment of the ATTAS and the DO 228 is largely compatible, but the ATTAS equipment is substantially more extensive, while the Dornier equipment is more mobile and can be installed in other aircraft without much effort. An integrated pulse code modulation (PCM) system digitizes the analog sensor signals and provides a sequential PCM data flow. The PCM data can be transmitted to ground station. ESA

N92-25593# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
GROUND INSTALLATIONS FOR THE PREPARATION AND EVALUATION OF FLIGHT TESTS [BODENEINRICHTUNGEN ZUR VORBEREITUNG UND AUSWERTUNG VON FLUGVERSUCHEN] **c09**
G.-J. Barth *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 49-56 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The possibilities of telemetric ground equipment to support flight tests are outlined. The available telemetric equipment can be used centrally for all flight tests, but does not cover the whole domain. Therefore, equipment for special tests is also available. Three groups of telemetric equipment (basic pulse code modulation (PCM) decommutators, decommutators with support, and PC decommutators) are introduced. The telemetric output of measured data in the classical analog way is treated. Calibrated data can be represented in the screen as figures or as bars. Time evolutions can be represented on the screen as well as on a recorder. ESA

N92-25594# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
INTRODUCTION AND EXECUTION OF FLIGHT TESTS AT THE DLR [EINLEITUNG UND ABWICKLUNG VON FLUGVERSUCHEN IN DER DLR] **c05**
Helmut Bothe *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 57-70 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The different test stands available for an efficient execution of flight tests are described. The onboard equipment comprises an airborne system for the reference flight path, avionics sensor systems, a data acquisition and transmission system, aeronautical radio systems, and an experimental cockpit. The ground equipment comprises a tracking radar, a laser radar, a kinotheodolite system, a telemetry receiver system with online data processing, a gyroscope test system, the air traffic simulator ATMOS, a ground test vehicle, and a high frequency radiation system. ESA

N92-25595# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
ATTAS EXPERIMENTAL COCKPIT AND ATMOS FOR FLIGHT CONTROL COMPONENTS AND SYSTEMS INVESTIGATIONS [ATTAS EXPERIMENTAL-COCKPIT UND ATMOS FUER KOMPONENTEN- UND SYSTEMUNTERSUCHUNGEN DER FLUGFUEHRUNG]
Ralf Beyer *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 71-84 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The experimental cockpit ATTAS (Advanced Technologies Testing Aircraft System) and the air traffic control simulator ATMOS (Air Traffic Management and Operations Simulator) are presented. ATTAS and ATMOS represent an air traffic control test environment

for the study of components and systems. Both systems, together with the data link between them, enable investigation in a realistic test environment of avionics and air traffic control systems, especially the interaction between airborne and ground systems.
ESA

N92-25596# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
TESTING OF AN EXPERIMENTAL FMS [ERPROBUNG EINES EXPERIMENTELLEN FMS] **c05**
Volkmar Adam *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 85-104 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The development of an Experimental Flight Management System (EFMS) and the validation and testing of the EFMS functions in a given test environment are discussed. The present air traffic control problems can only be solved by an integrated Air Traffic Management (ATM) system. Therefore, new FMS functions must be developed and their efficiency demonstrated in a simulated scenario of the future situation. The EFMS presently being developed in the framework of the program PHARE (Program for Harmonized ATM Research in Eurocontrol) is flexible and easy to adapt to experimental requirements. The testing procedure of the EFMS in flight and in connection with air traffic simulation is outlined.
ESA

N92-25597# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
TESTING CONCEPT OF A MOVEMENT AREA GUIDANCE [ERPROBUNGSKONZEPT EINES ROLLFUEHRUNGSSYSTEMS]
A. Becker *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 105-113 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The concept of an experimental movement status and communication system for airfield surface traffic is outlined. The concept is based on the planning, control, and guidance system TARMAC (Taxi And Ramp Management and Control System). The requirements concerning movement status determination, digital communication, and position determination are discussed. The existing concepts cannot fulfill all these requirements and therefore an integrated system consisting of several subsystems is necessary.
ESA

N92-25598# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
PALLET FOR HELICOPTER TESTING INSTRUMENTATION [PALETTE ZUR HUBSCHRAUBER-VERSUCHSINSTRUMENTIERUNG] **c06**
Georg Haehnlein and Peter Jaensch *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 114-153 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The conceptualization, realization, and application of a helicopter experimental platform are presented. The different factors influencing the helicopter system were identified and optimized with respect to higher mission requirements and an improved execution of the mission. The most varied user programs were conducted using a BO-105-S3 helicopter and the experience was exceptionally positive. The systems reliability is high and no failures occurred. The data acquisition components of the system were actualized several times. According to the concept, the hardware and software components of the data acquisition system are in a state of permanent technological upgrading.
ESA

N92-25599# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
DEVELOPMENT OF FLIGHT TESTING OF A FAULT TOLERANT FLY-BY-LIGHT YAW CONTROL SYSTEM [ENTWICKLUNG UND FLUGERPROBUNG EINES FEHLERTOLERANTEN FLY-BY-LIGHT GIERREGELUNGSSYSTEMS] **c08**
G. Mansfeld, K. Bender, and J. Tersteegen *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 154-176 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

A yaw control system based on optical signal transmission (Fly-By-Light (FBL)) was developed and tested in flight with a B0-105-S3 in order to evaluate the performance and efficiency of new technologies such as FBL, smart actuator, and redundancy management of multiprocessor systems. The systems concept is outlined. The yaw control system has a high dynamic range, complete actuator authority, and a minimal number of sensors. This yaw control system facilitates the task of the pilot, improves the flight path control, and makes the control more quiet. However, the system requires a high actuator authority and error tolerance, that is, a redundant control system with high disturbance resistance.
ESA

N92-25600# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
GROUND AND SATELLITE SUPPORTED FLIGHT TRAJECTORY MEASUREMENT BY EXAMPLE OF THE AVIONICS FLIGHT TEST SYSTEM AFES [BODEN- UND SATELLITENGESTUETZTE FLUGBAHNVERMESSUNG AM BEISPIEL DES AVIONIK-FLUGERPROBUNGSSYSTEMS AFES]
Bernhard Stieler and Karlheinz Hurrass *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 177-206 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The avionics flight evaluation system (AFES) is described. Its basic sensors are a microwave radar and an inertial system. The measured signals onboard the aircraft are used in optimal estimation algorithms and provide quasi online and accurate reference trajectory calculation. The different components of the system are described. The position accuracy (horizontal and vertical) of the AFES reference system is discussed. The planned improvements (powerful airborne computer, integrated height measuring system, and global positioning system as support sensor) are outlined.
ESA

N92-25601# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
BOARD-AUTONOMOUS FLIGHT TRAJECTORY MEASUREMENT BY EXAMPLE OF AN ILS MEASURING SYSTEM [BORDAUTONOME FLUGBAHNVERMESSUNG AM BEISPIEL EINES ILS-VERMESSUNGSSYSTEMS]
Bernhard Stieler and Karlheinz Hurrass *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 207-232 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

The possibilities and advantages of a completely board-autonomous flight trajectory measuring technique are discussed. The basic components are an inertial system, barometric and radar height measuring systems, and CCD (Charge Coupled Device) cameras. The present ILS (Instrument Landing System) system GFMS has to verify radio navigation systems for air traffic control. The concept of GFMS and the hitherto obtained results are discussed. Possibilities to improve the GFMS measuring system are given. Board-autonomous flight trajectory measuring systems supported by image processing are compared with ground and satellite supported systems.
ESA

N92-25602# Deutsche System-Technik G.m.b.H., Bremen (Germany, F.R.).
TESTING OF AN EXPERIMENTAL PHOTOGRAPHIC RECONNAISSANCE SYSTEM [ERPROBUNG EINES EXPERIMENTALSYSTEMS ZUR BILDAUFKLAERUNG] c35
H. Keil and P. Schulz (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) *In* DLR, Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 233-246 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

A scientific flight experiment system for image processing and disturbance safe image transmission was tested, with a view to a Remotely Piloted Vehicle application. The special features of the system are IR image representation and storage, evaluation in the ground station, systems and image sensor control from the ground station, and disturbance safe duplex radio transmission between test aircraft and ground station. This experimental system was demonstrated to be an excellent tool for studies in the field of disturbance safe photographic reconnaissance. Parameters such as the reduction factor of the information flow and the influence of perturbations can be determined. ESA

N92-25603# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
ARRANGEMENTS AND METHODS FOR THE SURVEY OF AIRCRAFT RADIO COMPONENTS AND SYSTEMS [EINRICHTUNGEN UND METHODEN ZUR VERMESSUNG VON FLUGFUNKKOMPONENTEN UND -SYSTEMEM] c06
Juergen Tetzlaff *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 247-259 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

A flight survey system for the inflight measurement of RF components and systems (antenna radiation patterns, radar reflection characteristics) was developed. The modular measuring systems are automated to reduce the time and cost requirements. After an online data evaluation, the measurements provide the quantity to be analyzed as a function of an angle (aspect angle) which is correlated to the aircraft coordinate system. The measuring equipment is calibrated before the flight. ESA

N92-26101# Systems Control Technology, Inc., Arlington, VA.
ROTORCRAFT TERMINAL ATC ROUTE STANDARDS Final Report
Raymond H. Matthews and Brian M. Sawyer Aug. 1991 77 p
(Contract DTFA01-87-C-00014)
(SCT-90RR-33; DOT/FAA/RD-90/18) Avail: NTIS HC/MF A05

Major aircraft terminal areas are examined and both visual and instrument meteorological conditions are addressed that are under visual flight rules (VFR), special visual flight rules (SVFR), and instrument flight rules (IFR). Their effect is assessed on the National Airspace System (NAS), the users, and air traffic control. The review, analysis, and development of rotorcraft ATC route structures is included along with the analysis of current procedures and standards, with the objective of recommending modifications to existing FAA documents, standards, and procedures which will enhance rotorcraft operations and NAS capacity in a terminal environment. This is one of a series of reports that address rotorcraft standards, route structures, and procedures applied by FAA air traffic facilities. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N92-25263*# California State Polytechnic Univ., Pomona. Dept. of Aerospace Engineering.
SHARP: SUBSONIC HIGH ALTITUDE RESEARCH PLATFORM Final Report
Todd Beals, Craig Burton, Aileen Cabatan, Christine Hermano, Tom Jones, Susan Lee, and Brian Radloff [1991] 92 p
(Contract NASw-4435)
(NASA-CR-190004; NAS 1.26:190004) Avail: NTIS HC/MF A05

The Universities Space Research Association is sponsoring an undergraduate program which is geared to designing an aircraft that can study the ozone layer at the equator. This aircraft must be able to satisfy four mission profiles. Mission one is a polar mission that ranges from Chile to the South Pole and back to Chile, a total range of 6000 n.mi. at 100,000 ft with a 2500 lb payload. The second mission is also a polar mission, with an altitude of 70,000 ft and an increased payload of 4000 lbs. For the third mission, the aircraft will takeoff at NASA Ames, cruise at 100,000 ft carrying a 2500 lb payload, and land at Puerto Montt, Chile. The final mission requires the aircraft to take off at NASA Ames, cruise at 100,000 ft with a 1000 lb payload, make an excursion to 120,000 ft, and land at Howard AFB, Panama. Three missions require that a subsonic Mach number be maintained due to constraints imposed by the air sampling equipment. The aircraft need not be manned for all four missions. Three aircraft configurations have been determined to be the most suitable for meeting the above requirements. In the event that a requirement cannot be obtained within the given constraints, recommendations for proposal modifications are given. Author

N92-25995*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRCRAFT OPTIMIZATION BY A SYSTEM APPROACH: ACHIEVEMENTS AND TRENDS
Jaroslaw Sobieszczanski-Sobieski May 1992 16 p Proposed for presentation at the 18th ICAS Congress, Beijing, China, 20-25 Sep. 1992
(NASA-TM-107622; NAS 1.15:107622) Avail: NTIS HC/MF A03

Recently emerging methodology for optimal design of aircraft treated as a system of interacting physical phenomena and parts is examined. The methodology is found to coalesce into methods for hierarchic, non-hierarchic, and hybrid systems all dependent on sensitivity analysis. A separate category of methods has also evolved independent of sensitivity analysis, hence suitable for discrete problems. References and numerical applications are cited. Massively parallel computer processing is seen as enabling technology for practical implementation of the methodology. Author

N92-26017*# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering and Engineering Mechanics.
TRAJECTORY OPTIMIZATION FOR THE NATIONAL AEROSPACE PLANE Final Report, 1 May 1991 - 30 May 1992
Ping Lu Jun. 1992 46 p
(Grant NAG1-1255)
(NASA-CR-190355; NAS 1.26:190355) Avail: NTIS HC/MF A03

The primary objective of this research is to develop an efficient and robust trajectory optimization tool for the optimal ascent problem of the National Aerospace Plane (NASP). This report is organized in the following order to summarize the complete work: Section two states the formulation and models of the trajectory optimization problem. An inverse dynamics approach to the problem is introduced in Section three. Optimal trajectories corresponding to various conditions and performance parameters are presented

in Section four. A midcourse nonlinear feedback controller is developed in Section five. Section six demonstrates the performance of the inverse dynamics approach and midcourse controller during disturbances. Section seven discusses rocket assisted ascent which may be beneficial when orbital altitude is high. Finally, Section eight recommends areas of future research.
H.A.

N92-26039# Naval Postgraduate School, Monterey, CA.
THE V-22 TILT ROTOR: A COMPARISON WITH EXISTING COAST GUARD AIRCRAFT M.S. Thesis
Jay D. Mahaffey Dec. 1991 118 p
(AD-A245843) Avail: NTIS HC/MF A06

The Coast Guard Office of Aviation Plans and Programs continues to receive inquiries from several sources about the service's intentions concerning the V-22 tilt rotor aircraft. Officially, decision makers acknowledge that tilt rotor capabilities could be readily adaptable to the service missions, but acquisition of the V-22 will not be contemplated unless the aircraft is first fielded by a Department of Defense component. This thesis serves as a preliminary inquiry into tilt rotor applications for the Coast Guard. The purpose of the study is to determine the implications of a favorable V-22 production decision on the Coast Guard's current mix of aircraft. As background material, the history of tilt rotor development is reviewed, and the key economic issues at the center of the public policy debate likely to decide the V-22's future are outlined. Then, the V-22 Osprey is compared with each aircraft already in Coast Guard service. Both performance characteristics and costs are examined. Lastly, potential Coast Guard V-22 assimilation strategies are reviewed. GRA

N92-26155# Naval Postgraduate School, Monterey, CA.
SIMULATION OF A ROTORCRAFT IN TURBULENT FLOWS M.S. Thesis
Robert D. Moran, Jr. Sep. 1991 102 p
(AD-A245742) Avail: NTIS HC/MF A06

Accurate simulation of helicopters in an at-sea-shipboard environment is desired to provide realistic operating envelopes without incurring the enormous cost of real-time flight tests. This study examines the simulation of rotorcraft in turbulent flow by looking at previous attempts at helicopter-ship interfacing, current efforts in this area, and what will be needed in the future. Part of this study is devoted to the construction of an analytic model of the tunnel strike problem of the CH-46 Sea Knight helicopter that is based on measurements made over the flight deck of a model ship. A computer model was constructed, with the aim of modeling the 'tunnel strike' during engagement aboard AOR type ships. The reminder of the study is concerned with the simulation of the motion of a helicopter in the turbulent wake of a DD-963 class ship. Results show that a sixth order transfer function can filter white noise to accurately model the turbulence spectra at specific points along a helicopter glide path in the wake. While a tunnel strike could not be successfully modeled using DYSCO software, a simple blade-element program was developed to show the aerodynamic forces on the rotor blades in a specific flow field over an AOR class ship flight deck. That program shows the location and magnitude of the aerodynamic forces contributing to the flapping of the rotor blades, which results in the rotor blades impacting the fuselage. GRA

N92-25591# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Flugabteilung.
THE DLR TEST AIRCRAFT IN FZ-BS VFW614/ATTAS, DORNIER DO228-101, MBB BO 105-S-3 [DIE DLR-VERSUCHSLUFTFAHRZEUGE IM FZ-BS, -VFW 614/ATTAS, DORNIER DO 228-101, MBB BO105 S-3]
Hans-L. Meyer *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 9-34 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

N92-25594# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
INTRODUCTION AND EXECUTION OF FLIGHT TESTS AT THE DLR [EINLEITUNG UND ABWICKLUNG VON FLUGVERSUCHEN IN DER DLR]
Helmut Bothe *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 57-70 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

N92-25596# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
TESTING OF AN EXPERIMENTAL FMS [ERPROBUNG EINES EXPERIMENTELLEN FMS]
Volkmar Adam *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 85-104 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

N92-25714*# Sverdrup Technology, Inc., Cleveland, OH.
GRID GENERATION FOR A COMPLEX AIRCRAFT CONFIGURATION
Jim Bruns *In* NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas Apr. 1992 p 17-27 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25919*# General Electric Co., Cincinnati, OH. Aircraft Engines.
HIGH SPEED CIVIL TRANSPORT
R. L. McKnight *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 173-188 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

N92-25920*# Pratt and Whitney Aircraft, West Palm Beach, FL.
STRUCTURES TECHNOLOGY APPLICATIONS FOR THE NATIONAL AEROSPACE PLANE
T. E. Little *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 189-208 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

N92-25921*# Wright Lab., Wright-Patterson AFB, OH.
LARGE SCALE OPTIMIZATION USING ASTROS: AN OVERVIEW
Vipperia B. Venkayya *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 209-230 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

N92-25922*# Virginia Univ., Charlottesville. Light Thermal Structures Center.
LIGHT THERMAL STRUCTURES AND MATERIALS FOR HIGH SPEED FLIGHT
Earl A. Thornton *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 231-251 Sponsored in part by Virginia Univ. Academic Enhancement Program (For primary document see N92-25911 16-39)
(Grants NAG1-745; NAG1-1013)
Avail: NTIS HC/MF A22

N92-25931*# Wright Lab., Wright-Patterson AFB, OH.
AIRFRAME LIFE PREDICTION
G. P. Sendeckyj *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion

Systems May 1992 p 431-445 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

N92-25935*# General Electric Co., Cincinnati, OH.
COMPUTATIONAL STRUCTURES TECHNOLOGY ENGINE/AIRFRAME COUPLING
Bruce C. McClintick *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 507-520 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N92-25592# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
THE BASIC MEASURING TECHNICAL EQUIPMENT OF THE DLR TEST AIRCRAFT [DIE MESSTECHNISCHE GRUNDAUSRUESTUNG DER DLR-VERSUCHSFLUGZEUGE]
Helmut Bothe *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 35-48 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

N92-25598# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
PALLET FOR HELICOPTER TESTING INSTRUMENTATION [PALETTE ZUR HUBSCHRAUBER-VERSUCHSINSTRUMENTIERUNG]
Georg Haehnlein and Peter Jaensch *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 114-153 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

N92-25603# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
ARRANGEMENTS AND METHODS FOR THE SURVEY OF AIRCRAFT RADIO COMPONENTS AND SYSTEMS [EINRICHTUNGEN UND METHODEN ZUR VERMESSUNG VON FLUGFUNKKOMPONENTEN UND -SYSTEMEM]
Juergen Tetzlaff *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 247-259 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-25164*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE FUTURE CHALLENGE FOR AEROPROPULSION
Robert Rosen (National Aeronautics and Space Administration, Washington, DC.) and David N. Bowditch 1992 14 p Presented at the Aeroengine 1992, Moscow, USSR, 6-12 Apr. 1992
(NASA-TM-105613; E-6943; NAS 1.15:105613) Avail: NTIS HC/MF A03

NASA's research in aeropropulsion is focused on improving the efficiency, capability, and environmental compatibility for all classes of future aircraft. The development of innovative concepts, and theoretical, experimental, and computational tools provide the knowledge base for continued propulsion system advances. Key enabling technologies include advances in internal fluid mechanics, structures, light-weight high-strength composite materials, and advanced sensors and controls. Recent emphasis has been on the development of advanced computational tools in internal fluid mechanics, structural mechanics, reacting flows, and computational chemistry. For subsonic transport applications, very high bypass ratio turbofans with increased engine pressure ratio are being investigated to increase fuel efficiency and reduce airport noise levels. In a joint supersonic cruise propulsion program with industry, the critical environmental concerns of emissions and community noise are being addressed. NASA is also providing key technologies for the National Aerospaceplane, and is studying propulsion systems that provide the capability for aircraft to accelerate to and cruise in the Mach 4-6 speed range. The combination of fundamental, component, and focused technology development underway at NASA will make possible dramatic advances in aeropropulsion efficiency and environmental compatibility for future aeronautical vehicles. Author

N92-25712*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
WORKSHOP ON GRID GENERATION AND RELATED AREAS
Apr. 1992 160 p Workshop held in Cleveland, OH, 14-15 Nov. 1991
(NASA-CP-10089; E-6823; NAS 1.55:10089) Avail: NTIS HC/MF A08

A collection of papers given at the Workshop on Grid Generation and Related Areas is presented. The purpose of this workshop was to assemble engineers and scientists who are currently working on grid generation for computational fluid dynamics (CFD), surface modeling, and related areas. The objectives were to provide an informal forum on grid generation and related topics, to assess user experience, to identify needs, and to help promote synergy among engineers and scientists working in this area. The workshop consisted of four sessions representative of grid generation and surface modeling research and application within NASA LeRC. Each session contained presentations and an open discussion period. For individual titles, see N92-25713 through N92-25727.

N92-25713*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GRID MANAGEMENT **c02**
Danny Hwang *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 3-15 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

A computational environment that allows many Computational Fluid Dynamics (CFD) engineers to work on the same project exists in the Special Project Office (SPO). This environment enables several users to carry out the task of grid generation. The grid management system, used by the engineers, is described in a brief overview. The topics will include the grid file naming system, the grid-generation procedure, grid storage, and the grid format standard. Author

N92-25714*# Sverdrup Technology, Inc., Cleveland, OH.
GRID GENERATION FOR A COMPLEX AIRCRAFT CONFIGURATION **c05**
Jim Bruns *In* NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas Apr. 1992 p 17-27 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

The procedure used to create a grid around the F/A-18 fighter aircraft is presented. This work was done for the NASA High

Alpha Technology Program. As part of this program, LeRC is numerically and experimentally investigating the flow in the F/A-18 inlet duct at high angles of attack. A grid was needed which could be used to calculate both the external and internal flow around the F/A-18. The grid had to be compatible with the computational fluid dynamics (CFD) codes PARC3D and CFL3D. The programs used to create this grid were I3GVIRGO and GRIDGEN. A surface definition used to create the grid was obtained from McDonnell Aircraft Company (MCAIR) and was composed of numerous files each containing a point definition of a portion of the aircraft. These files were read into the geometry manipulation program I3GVIRGO, where they were modified and grouped into smaller GRIDGEN database files. Next, the block outlines and boundary conditions were specified in the GRIDBLOCK program. The GRIDGEN2D program was used to create the surface grid on the block faces, and GRIDGEN3D was used to create the full 3-D grid. Author

N92-25715*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

QX MAN: Q AND X FILE MANIPULATION c61

Mark A. Krein *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 29-33 (For primary document see N92-25712 16-07)

Avail: NTIS HC/MF A08

QX MAN is a grid and solution file manipulation program written primarily for the PARC code and the GRIDGEN family of grid generation codes. QX MAN combines many of the features frequently encountered in grid generation, grid refinement, the setting-up of initial conditions, and post processing. QX MAN allows the user to manipulate single block and multi-block grids (and their accompanying solution files) by splitting, concatenating, rotating, translating, re-scaling, and stripping or adding points. In addition, QX MAN can be used to generate an initial solution file for the PARC code. The code was written to provide several formats for input and output in order for it to be useful in a broad spectrum of applications. Author

N92-25716*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TCGRID: A THREE DIMENSIONAL C-GRID GENERATOR FOR TURBOMACHINERY

Rodrick V. Chima *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 39-53 (For primary document see N92-25712 16-07)

Avail: NTIS HC/MF A08

A fast 3-D grid code for turbomachinery was developed. The code, TCGRID (Turbomachinery C-GRID), can generate either C or H type grids for fairly arbitrary axial or radical turbomachinery geometries. The code also has limited blocked grid capability and can generate an axisymmetric H type grid upstream of the blade row or an O type grid within the tip clearance region. Hub and tip geometries are input as a simple list of pairs: All geometric data is handled using parametric splines so that geometries that turn 90 degrees can be handled without difficulty. Blade input is in standard MERIDL or Lewis compressor design code format. TCGRID adds leading and trailing edge circles to MERIDL geometries and intersects the blade with the hub and tip if necessary using a novel intersection algorithm. The procedure used to generate the grid is given. Output is in PLOT3D format, which can also be read by the RVC3D (Rotor Viscous Code 3-D) Navier-Stokes code for turbomachinery. Intermediate 2-D or 3-D grids useful for debug and other purposes can also be output using a convenient output flag. A grid generated figure is given. Author

N92-25717*# Sverdrup Technology, Inc., Cleveland, OH.

AN INTERACTIVE GRID GENERATION TECHNIQUE FOR TURBOMACHINERY Abstract Only

Tim Beach *In* NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas Apr. 1992 p 55-56 (For primary document see N92-25712 16-07)

Avail: NTIS HC/MF A08

A combination algebraic/elliptic technique is presented for the generation of 3-D grids about turbomachinery blade rows for both axial and radial flow machinery. The technique is build around use of an advanced engineering workstation to construct several 2-D grids interactively on predetermined blade-to-blade surfaces. A 3-D grid is generated by interpolating these surface grids onto an axisymmetric grid. On each blade to blade surface, a grid is created using algebraic techniques near the blade to control orthogonality within the boundary layer region and elliptic techniques in the mid-passage to achieve smoothness. The interactive definition of bezier curves as internal boundaries is the key to simple construction. The approach is adapted for use with the average passage solution technique, although this is not a limitation for most other uses. A variety of examples are presented. Author

N92-25718*# Mississippi State Univ., State College. Engineering Research Center.

TIGER: TURBOMACHINERY INTERACTIVE GRID GENERATION

Bharat K. Soni, Ming-Hsin Shih, and J. Mark Janus *In* NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas Apr. 1992 p 57-63 (For primary document see N92-25712 16-07)

Avail: NTIS HC/MF A08

A three dimensional, interactive grid generation code, TIGER, is being developed for analysis of flows around ducted or unducted propellers. TIGER is a customized grid generator that combines new technology with methods from general grid generation codes. The code generates multiple block, structured grids around multiple blade rows with a hub and shroud for either C grid or H grid topologies. The code is intended for use with a Euler/Navier-Stokes solver also being developed, but is general enough for use with other flow solvers. TIGER features a silicon graphics interactive graphics environment that displays a pop-up window, graphics window, and text window. The geometry is read as a discrete set of points with options for several industrial standard formats and NASA standard formats. Various splines are available for defining the surface geometries. Grid generation is done either interactively or through a batch mode operation using history files from a previously generated grid. The batch mode operation can be done either with a graphical display of the interactive session or with no graphics so that the code can be run on another computer system. Run time can be significantly reduced by running on a Cray-YMP. Author

N92-25719*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TIGGERC: TURBOMACHINERY INTERACTIVE GRID GENERATOR ENERGY DISTRIBUTOR AND RESTART CODE

David P. Miller *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 65-73 (For primary document see N92-25712 16-07)

Avail: NTIS HC/MF A08

A two dimensional multi-block grid generator was developed for a new design and analysis system for studying multi-blade row turbomachinery problems with an axisymmetric viscous/inviscid 'average passage' through flow code. TIGGERC is a mouse driven, fully interactive grid generation program which can be used to modify boundary coordinates and grid packing. TIGGERC generates grids using a hyperbolic tangent or algebraic distribution of grid points on the block boundaries and the interior points of each block grid are distributed using a transfinite interpolation approach. TIGGERC generates a blocked axisymmetric H grid, C grid, I grid, or O grid for studying turbomachinery flow problems. TIGGERC was developed for operation on small high speed graphic workstations. Author

N92-25720*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

MULTIBLOCK GRID GENERATION FOR JET ENGINE CONFIGURATIONS

Mark E. M. Stewart *In its* Workshop on Grid Generation and

Related Areas Apr. 1992 p 79-84 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

The goal was to create methods for generating grids with minimal human intervention that are applicable to a wide range of problems and compatible with existing numerical methods and with existing and proposed computers. The following topics that are related to multiblock grid generation are briefly covered in viewgraph form: finding a domain decomposition, dimensioning grids, grid smoothing, manipulating grids and decompositions, and some specializations for jet engine configurations. Author

N92-25721*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TWO-DIMENSIONAL UNSTRUCTURED TRIANGULAR GRID GENERATION **c34**
Philip C. E. Jorgenson *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 85-106 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

The capability of generating 2-D unstructured triangular meshes about arbitrary geometries is demonstrated. This work uses a distribution of boundary points and triangulates the computational domain using a Delaunay triangulation algorithm. Typically, initial cells are added based on cell aspect ratios or cell areas. A resulting mesh can then be used along with the connectivity of the cells to solve either a Euler or Navier-Stokes flow problem. Author

N92-25722*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CARTESIAN BASED GRID GENERATION/ADAPTIVE MESH REFINEMENT **c34**
William J. Coirier *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 107-120 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

Grid adaptation has recently received attention in the computational fluid dynamics (CFD) community as a means to capture the salient features of a flowfield by either moving grid points of a structured or by adding cells in an unstructured manner. An approach based on a background cartesian mesh is investigated from which the geometry is 'cut' out of the mesh. Once the mesh is obtained, a solution on this coarse grid is found, that indicates which cells need to be refined. This process of refining/solving continues until the flow is grid refined in terms of a user specified global parameter (such as drag coefficient etc.). The advantages of this approach are twofold: the generation of the base grid is independent of the topology of the bodies or surfaces around/through which the flow is to be computed, and the resulting grid (in uncut regions) is highly isotropic, so that the truncation error is low. The flow solver (which, along with the grid generation is still under development) uses a completely unstructured data base, and is a finite volume, upwinding scheme. Current and future work will address generating Navier-Stokes suitable grids by using locally aligned and normal face/cell refining. The attached plot shows a simple grid about two turbine blades. Author

N92-25723*# Ohio State Univ., Columbus.
GRID GENERATION RESEARCH AT OSU Abstract Only **c02**
S. Nakamura *In* NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas Apr. 1992 p 121 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

In the last two years, effort was concentrated on: (1) surface modeling; (2) surface grid generation; and (3) 3-D flow space grid generation. The surface modeling shares the same objectives as the surface modeling in computer aided design (CAD), so software available in CAD can in principle be used for solid modeling. Unfortunately, however, the CAD software cannot be easily used in practice for grid generation purposes, because they are not designed to provide appropriate data base for grid generation. Therefore, we started developing a generalized surface modeling software from scratch, that provides the data base for the surface grid generation. Generating surface grid is an important step in generating a 3-D space for flow space. To generate a surface grid on a given surface representation, we developed a unique algorithm that works on any non-smooth surfaces. Once the surface grid is generated, a 3-D space can be generated. For this purpose, we also developed a new algorithm, which is a hybrid of the hyperbolic and the elliptic grid generation methods. With this hybrid method, orthogonality of the grid near the solid boundary can be easily achieved without introducing empirical fudge factors. Work to develop 2-D and 3-D grids for turbomachinery blade geometries was performed, and as an extension of this research we are planning to develop an adaptive grid procedure with an interactive grid environment. Author

N92-25724*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTERACTIVE SOLUTION-ADAPTIVE GRID GENERATION PROCEDURE **c61**
Yung K. Choo and Todd Henderson *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 123-138 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

TURBO-AD is a two dimensional interactive solution adaptive grid generation program. The code uniquely combines a grid adaptation technique that uses parametric mapping with control sources and an algebraic grid generation that uses control points into a single software package. The grid adaptation is achieved by first adapting the control points to a numerical solution in the parametric domain using the control sources obtained from flow properties. Then a new grid is generated from the adapted control net using the control point formulation. The new adapted grid in the parametric domain is then mapped back to the physical domain. This solution adaptive grid generation process is efficient because the number of control points is much less than the number of grid points and the grid generation from the adapted control net is an efficient algebraic process. Author

N92-25725*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA SURFACE-MODELING AND GRID-GENERATION (SM/GG) ACTIVITIES **c81**
Yung K. Choo *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 143-149 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

A NASA Steering Committee was formed to carry out the recommendations from the NASA Workshop on Future Directions in Surface Modeling and Grid Generation. Its function is to communicate and coordinate within NASA the acquisition and distribution of geometry/grid generation software/data, establish geometry data exchange standards, and interface with other government, university, and industry efforts. Two speakers present the committee's activities in viewgraph format. H.A.

N92-25726*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACTIVITIES FOR NUMERICAL PROPULSION SYSTEMS SIMULATION PROGRAM **c61**
Austin L. Evans *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 151-157 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

The Interdisciplinary Technology Office (ITO) has been tasked with the responsibility of coordinating interdisciplinary research and technology programs; establish and maintain interface with the various disciplines at LeRC, industry, government, and academic organizations; and facilitating the exploitation of advances in the individual disciplinary efforts that have multidisciplinary implications. H.A.

N92-25727*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTEGRATING AERODYNAMIC SURFACE MODELING FOR COMPUTATIONAL FLUID DYNAMICS WITH COMPUTER AIDED STRUCTURAL ANALYSIS, DESIGN, AND MANUFACTURING **c34**
Scott A. Thorp *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 159-168 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

This presentation will discuss the development of a NASA Geometry Exchange Specification for transferring aerodynamic surface geometry between LeRC systems and grid generation software used for computational fluid dynamics research. The proposed specification is based on a subset of the Initial Graphics Exchange Specification (IGES). The presentation will include discussion of how the NASA-IGES standard will accommodate improved computer aided design inspection methods and reverse engineering techniques currently being developed. The presentation is in viewgraph format. Author

N92-25808*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTATIONAL FLUID DYNAMICS
Feb. 1992 219 p Conference held at Moffett Field, CA, 12-14 Mar. 1991; sponsored by NASA. Ames Research Center Original contains color illustrations
(NASA-CP-10078; E-6374; NAS 1.55:10078) Avail: NTIS HC/MF A10; 11 functional color pages

This collection of papers was presented at the Computational Fluid Dynamics (CFD) Conference held at Ames Research Center in California on March 12 through 14, 1991. It is an overview of CFD activities at NASA Lewis Research Center. The main thrust of computational work at Lewis is aimed at propulsion systems. Specific issues related to propulsion CFD and associated modeling will also be presented. Examples of results obtained with the most recent algorithm development will also be presented. For individual titles, see N92-25809 through N92-25827.

N92-25809*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF NEW FLUX SPLITTING SCHEMES **c34**
Meng-Sing Liou and Christopher J. Steffen, Jr. *In its* Computational Fluid Dynamics Feb. 1992 p 19-28 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Maximizing both accuracy and efficiency has been the primary objective in designing a numerical algorithm for computational fluid dynamics (CFD). This is especially important for solutions of complex three dimensional systems of Navier-Stokes equations which often include turbulence modeling and chemistry effects. Recently, upwind schemes have been well received for their capability in resolving discontinuities. With this in mind, presented are two new flux splitting techniques for upwind differencing. The first method is based on High-Order Polynomial Expansions (HOPE) of the mass flux vector. The second new flux splitting is based on the Advection Upwind Splitting Method (AUSM). The calculation of the hypersonic conical flow demonstrates the accuracy of the splitting in resolving the flow in the presence of strong gradients. A second series of tests involving the two dimensional inviscid flow over a NACA 0012 airfoil demonstrates the ability of the AUSM to resolve the shock discontinuity at transonic speed. A third case calculates a series of supersonic flows over a circular cylinder. Finally, the fourth case deals with tests of a two dimensional shock wave/boundary layer interaction. H.A.

N92-25810*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN ITERATIVE IMPLICIT DDADI ALGORITHM FOR SOLVING THE NAVIER-STOKES EQUATION **c34**
S. C. Chen, N. S. Liu, and H. D. Kim *In its* Computational Fluid Dynamics Feb. 1992 p 29-46 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

An algorithm utilizing a first order upwind split flux technique and the diagonally dominant treatment is proposed to be the temporal operator for solving the Navier-Stokes equations. Given the limit of a five point stencil, the right hand side flux derivatives are formulated by several commonly used central and upwind schemes. Their performances are studied through a test case of free vortex convection in a uniform stream. From these results, a superior treatment for evaluating the flux term is proposed and compared with the rest. The application of the proposed algorithm to the full Navier-Stokes equations is demonstrated through a calculation of flow over a backward facing step. Results are compared against the calculation done by using the fourth order central differencing scheme with artificial damping. H.A.

N92-25811*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE PROTEUS NAVIER-STOKES CODE **c34**
Charles E. Towne and John R. Schwab *In its* Computational Fluid Dynamics Feb. 1992 p 47-56 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

An effort is currently underway at NASA Lewis to develop two and three dimensional Navier-Stokes codes, called Proteus, for aerospace propulsion applications. Proteus solves the Reynolds-averaged, unsteady, compressible Navier-Stokes equations in strong conservation law form. Turbulence is modeled using a Baldwin-Lomax based algebraic eddy viscosity model. In addition, options are available to solve thin layer or Euler equations, and to eliminate the energy equation by assuming constant stagnation enthalpy. An extensive series of validation cases have been run, primarily using the two dimensional planar/axisymmetric version of the code. Several flows were computed that have exact solution such as: fully developed channel and pipe flow; Couette flow with and without pressure gradients; unsteady Couette flow formation; flow near a suddenly accelerated flat plate; flow between concentric rotating cylinders; and flow near a rotating disk. The two dimensional version of the Proteus code has been released, and the three dimensional code is scheduled for release in late 1991. H.A.

N92-25812*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACCURATE UPWIND-MONOTONE (NONOSCILLATORY) METHODS FOR CONSERVATION LAWS **c34**
Hung T. Huynh *In its* Computational Fluid Dynamics Feb. 1992 p 57-64 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

The well known MUSCL scheme of Van Leer is constructed using a piecewise linear approximation. The MUSCL scheme is second order accurate at the smooth part of the solution except at extrema where the accuracy degenerates to first order due to the monotonicity constraint. To construct accurate schemes which are free from oscillations, the author introduces the concept of upwind monotonicity. Several classes of schemes, which are upwind monotone and of uniform second or third order accuracy are then presented. Results for advection with constant speed are shown. It is also shown that the new scheme compares favorably with state of the art methods. H.A.

N92-25813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUMERICAL SIMULATION OF CONSERVATION LAWS **c34**
Chung-Chang Sin and Ming To Wai (Sverdrup Technology, Inc., Cleveland, OH.) *In its* Computational Fluid Dynamics Feb. 1992 p 65-74 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

A new numerical framework for solving conservation laws is being developed. This new approach differs substantially from the well established methods, i.e., finite difference, finite volume, finite element and spectral methods, in both concept and methodology. The key features of the current scheme include: (1) direct

discretization of the integral forms of conservation laws, (2) treating space and time on the same footing, (3) flux conservation in space and time, and (4) unified treatment of the convection and diffusion fluxes. The model equation considered in the initial study is the standard one dimensional unsteady constant-coefficient convection-diffusion equation. In a stability study, it is shown that the principal and spurious amplification factors of the current scheme, respectively, are structurally similar to those of the leapfrog/DuFort-Frankel scheme. As a result, the current scheme has no numerical diffusion in the special case of pure convection and is unconditionally stable in the special case of pure diffusion. Assuming smooth initial data, it will be shown theoretically and numerically that, by using an easily determined optimal time step, the accuracy of the current scheme may reach a level which is several orders of magnitude higher than that of the MacCormack scheme, with virtually identical operation count. Author

N92-25814*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A NEW LAGRANGIAN METHOD FOR REAL GASES AT SUPERSONIC SPEED **c02**

C. Y. Loh and Meng-Sing Liou *In its* Computational Fluid Dynamics Feb. 1992 p 75-81 (For primary document see N92-25808 16-07)

Avail: NTIS HC/MF A10; 11 functional color pages

With the renewed interest in high speed flights, the real gas effect is of theoretical as well as practical importance. In the past decade, upwind splittings or Godunov-type Riemann solutions have received tremendous attention and as a result significant progress has been made both in the ideal and non-ideal gas. In this paper, we propose a new approach that is formulated using the Lagrangian description, for the calculation of supersonic/hypersonic real gas inviscid flows. This new formulation avoids the grid generation step which is automatically obtained as the solution procedure marches in the 'time-like' direction. As a result, no remapping is required and the accuracy is faithfully maintained in the Lagrangian level. In this paper, we give numerical results for a variety of real gas problems consisting of essential elements in high speed flows, such as shock waves, expansion waves, slip surfaces and their interactions. Finally, calculations for flows in a generic inlet and nozzle are presented. Author

N92-25815*# Sverdrup Technology, Inc., Cleveland, OH.

A TIME-ACCURATE IMPLICIT METHOD FOR CHEMICAL NON-EQUILIBRIUM FLOWS AT ALL SPEEDS **c34**

Jian-Shun Shuen *In* NASA. Lewis Research Center, Computational Fluid Dynamics Feb. 1992 p 83-91 (For primary document see N92-25808 16-07)

Avail: NTIS HC/MF A10; 11 functional color pages

A new time accurate coupled solution procedure for solving the chemical non-equilibrium Navier-Stokes equations over a wide range of Mach numbers is described. The scheme is shown to be very efficient and robust for flows with velocities ranging from M less than or equal to 10(exp -10) to supersonic speeds. Author

N92-25816*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STUDY OF SHOCK-INDUCED COMBUSTION USING AN IMPLICIT TVD SCHEME **c25**

Shayne Yungster *In its* Computational Fluid Dynamics Feb. 1992 p 93-101 Original contains color illustrations (For primary document see N92-25808 16-07)

Avail: NTIS HC/MF A10; 11 functional color pages

The supersonic combustion flowfields associated with various hypersonic propulsion systems, such as the ram accelerator, the oblique detonation wave engine, and the scramjet, are being investigated using a new computational fluid dynamics (CFD) code. The code solves the fully coupled Reynolds-averaged Navier-Stokes equations and species continuity equations in an efficient manner. It employs an iterative method and a second order differencing scheme to improve computational efficiency. The code is currently being applied to study shock wave/boundary layer interactions in premixed combustible gases, and to investigate the ram accelerator concept. Results obtained for a ram accelerator configuration indicate a new combustion mechanism in which a shock wave induces combustion in the boundary layer, which then propagates outward and downstream. The combustion process creates a high pressure region over the back of the projectile resulting in a net positive thrust forward. H.A.

N92-25817*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

UPWIND SCHEMES AND BIFURCATING SOLUTIONS IN REAL GAS COMPUTATIONS **c34**

Ambady Suresh (Sverdrup Technology, Inc., Cleveland, OH.) and Meng-Sing Liou *In its* Computational Fluid Dynamics Feb. 1992 p 103-114 (For primary document see N92-25808 16-07)

Avail: NTIS HC/MF A10; 11 functional color pages

The area of high speed flow is seeing a renewed interest due to advanced propulsion concepts such as the National Aerospace Plane (NASP), Space Shuttle, and future civil transport concepts. Upwind schemes to solve such flows have become increasingly popular in the last decade due to their excellent shock capturing properties. In the first part of this paper the authors present the extension of the Osher scheme to equilibrium and non-equilibrium gases. For simplicity, the source terms are treated explicitly. Computations based on the above scheme are presented to demonstrate the feasibility, accuracy and efficiency of the proposed scheme. One of the test problems is a Chapman-Jouguet detonation problem for which numerical solutions have been known to bifurcate into spurious weak detonation solutions on coarse grids. Results indicate that the numerical solution obtained depends both on the upwinding scheme used and the limiter employed to obtain second order accuracy. For example, the Osher scheme gives the correct CJ solution when the super-bee limiter is used, but gives the spurious solution when the Van Leer limiter is used. With the Roe scheme the spurious solution is obtained for all limiters. H.A.

N92-25818*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

HIGH ORDER PARALLEL NUMERICAL SCHEMES FOR SOLVING INCOMPRESSIBLE FLOWS **c34**

Avi Lin (Pennsylvania Univ., Philadelphia.), Edward J. Milner, May-Fun Liou, and Richard A. Belch *In its* Computational Fluid Dynamics Feb. 1992 p 115-131 Original contains color illustrations (For primary document see N92-25808 16-07)

Avail: NTIS HC/MF A10; 11 functional color pages

The use of parallel computers for numerically solving flow fields has gained much importance in recent years. This paper introduces a new high order numerical scheme for computational fluid dynamics (CFD) specifically designed for parallel computational environments. A distributed MIMD system gives the flexibility of treating different elements of the governing equations with totally different numerical schemes in different regions of the flow field. The parallel decomposition of the governing operator to be solved is the primary parallel split. The primary parallel split was studied using a hypercube like architecture having clusters of shared memory processors at each node. The approach is demonstrated using examples of simple steady state incompressible flows. Future studies should investigate the secondary split because, depending on the numerical scheme that each of the processors applies and the nature of the flow in the specific subdomain, it may be possible for a processor to seek better, or higher order, schemes for its particular subcase. H.A.

N92-25819*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AN EFFICIENT AND ROBUST ALGORITHM FOR TIME DEPENDENT VISCOUS INCOMPRESSIBLE NAVIER-STOKES EQUATIONS **c34**

John W. Goodrich *In its* Computational Fluid Dynamics Feb. 1992 p 133-141 (For primary document see N92-25808 16-07)

Avail: NTIS HC/MF A10; 11 functional color pages

A recently developed finite difference algorithm is presented for steady incompressible Navier-Stokes calculations. The algorithm is extremely robust with respect to Reynolds number, and has been used to directly compute incompressible flows with smoothly resolved streamfunction, kinetic energy and vorticity contours for Reynolds numbers as high as Re = 100,000 without requiring any subscale modelling. The algorithm is second order accurate in both time and space, with Crank-Nicolson differencing for the diffusion terms, with a lagged second order Adams-Basforth differencing for the convection terms, and with central differencing for all space derivatives. The algorithm is extremely efficient with respect to both computing time and physical memory. Solutions are shown for cavity and channel flows at various Reynolds numbers. H.A.

N92-25820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCES IN ENGINEERING TURBULENCE MODELING **c34**
T.-H. Shih *In its* Computational Fluid Dynamics Feb. 1992 p 143-161 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Some new developments in two equation models and second order closure models are presented. In this paper, modified two equation models are proposed to remove shortcomings such as computing flows over complex geometries and the ad hoc treatment near the separation and reattachment points. The calculations using various two equation models are compared with direct numerical solutions of channel flows and flat plate boundary layers. Development of second order closure models will also be discussed with emphasis on the modeling of pressure related correlation terms and dissipation rates in the second moment equations. All existing models poorly predict the normal stresses near the wall and fail to predict the three dimensional effect of mean flow on the turbulence. The newly developed second order near-wall turbulence model to be described in this paper is capable of capturing the near-wall behavior of turbulence as well as the effect of three dimension mean flow on the turbulence. Author

N92-25821*# Sverdrup Technology, Inc., Cleveland, OH.
ON RECONTAMINATION AND DIRECTIONAL-BIAS PROBLEMS IN MONTE CARLO SIMULATION OF PDF TURBULENCE MODELS **c34**
Andrew T. Hsu *In* NASA. Lewis Research Center, Computational Fluid Dynamics Feb. 1992 p 163-174 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Turbulent combustion can not be simulated adequately by conventional moment closure turbulent models. The probability density function (PDF) method offers an attractive alternative: in a PDF model, the chemical source terms are closed and do not require additional models. Because the number of computational operations grows only linearly in the Monte Carlo scheme, it is chosen over finite differencing schemes. A grid dependent Monte Carlo scheme following J.Y. Chen and W. Kollmann has been studied in the present work. It was found that in order to conserve the mass fractions absolutely, one needs to add further restrictions to the scheme, namely alpha(sub j) + gamma(sub j) = alpha(sub j - 1) + gamma(sub j + 1). A new algorithm was devised that satisfied this restriction in the case of pure diffusion or uniform flow problems. Using examples, it is shown that absolute conservation can be achieved. Although for non-uniform flows absolute conservation seems impossible, the present scheme has reduced the error considerably. H.A.

N92-25822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPLEMENTATION OF A KAPPA-EPSILON TURBULENCE MODEL TO RPLUS3D CODE **c34**
Tawit Chitsomboon *In its* Computational Fluid Dynamics Feb. 1992 p 175-180 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

The RPLUS3D code has been developed at the NASA Lewis Research Center to support the National Aerospace Plane (NASP) project. The code has the ability to solve three dimensional flowfields with finite rate combustion of hydrogen and air. The combustion process of the hydrogen-air system are simulated by an 18 reaction path, 8 species chemical kinetic mechanism. The code uses a Lower-Upper (LU) decomposition numerical algorithm as its basis, making it a very efficient and robust code. Except for the Jacobian matrix for the implicit chemistry source terms, there is no inversion of a matrix even though a fully implicit numerical algorithm is used. A k-epsilon turbulence model has recently been incorporated into the code. Initial validations have been conducted for a flow over a flat plate. Results of the validation studies are shown. Some difficulties in implementing the k-epsilon equations to the code are also discussed. Author

N92-25823*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TURBULENCE AND DETERMINISTIC CHAOS **c34**
Robert G. Deissler *In its* Computational Fluid Dynamics Feb. 1992 p 181-192 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Several turbulent and nonturbulent solutions of the Navier-Stokes equations are obtained. The unaveraged equations are used numerically in conjunction with tools and concepts from nonlinear dynamics, including time series, phase portraits, Poincare sections, largest Liapunov exponents, power spectra, and strange attractors. Initially neighboring solutions for a low Reynolds number fully developed turbulence are compared. Several flows are noted: fully chaotic, complex periodic, weakly chaotic, simple periodic, and fixed-point. Of these, only fully chaotic is classified as turbulent. Besides the sustained flows, a flow which decays as it becomes turbulent is examined. For the finest grid, 128(exp 3) points, the spatial resolution appears to be quite good. As a final note, the variation of the velocity derivatives skewness of a Navier-Stokes flow as the Reynolds number goes to zero is calculated numerically. The value of the skewness is shown to become small at low Reynolds numbers, in agreement with intuitive arguments that nonlinear terms should be negligible. Author

N92-25824*# Colorado Univ., Boulder.
STABILITY OF COMPRESSIBLE TAYLOR-COUETTE FLOW **c34**
K. Kao and C. Chow *In* NASA. Lewis Research Center, Computational Fluid Dynamics Feb. 1992 p 193-203 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

The objectives of this paper are to: (1) develop both analytical and numerical tools that can be used to predict the onset of instability and subsequently to simulate the transition process by which the originally laminar flow evolves into a turbulent flow; and (2) conduct the preliminary investigations with the purpose of understanding the mechanisms of the vortical structures of the compressible flow between tow concentric cylinders. Author

N92-25825*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNIQUES FOR ANIMATION OF CFD RESULTS **c34**
Jay Horowitz and Jeffery C. Hanson (Sverdrup Technology, Inc., Cleveland, OH.) *In its* Computational Fluid Dynamics Feb. 1992 p 205-217 Original contains color illustrations (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Video animation is becoming increasingly vital to the computational fluid dynamics researcher, not just for presentation, but for recording and comparing dynamic visualizations that are beyond the current capabilities of even the most powerful graphic workstation. To meet these needs, Lewis Research Center has recently established a facility to provide users with easy access to advanced video animation capabilities. However, producing animation that is both visually effective and scientifically accurate involves various technological and aesthetic considerations that

must be understood both by the researcher and those supporting the visualization process. These considerations include: scan conversion, color conversion, and spatial ambiguities. Author

N92-25826*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DISTRIBUTED VISUALIZATION FOR COMPUTATIONAL FLUID DYNAMICS **c34**
Don J. Sosoka and Anthony A. Facca *In its* Computational Fluid Dynamics Feb. 1992 p 219-223 Original contains color illustrations (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Distributed concurrent visualization and computation in computational fluid dynamics (CFD) is not a new concept. Specialized applications such as Realtime Interactive Particle-tracer (RIP) and vendor specific tools like Distributed Graphics Language (DGL) have been in use for some time. This paper describes a current project underway at NASA Lewis Research Center to provide the CFD researcher with an easy method for incorporating distributed processing concepts into program development. Details on the FORTRAN capable interface to a set of network and visualization functions are presented along with some results from initial CFD case studies that employ these techniques. H.A.

N92-25827*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNIQUES FOR GRID MANIPULATION AND ADAPTATION **c34**
Yung K. Choo, Peter R. Eisemann, and Ki D. Lee (Illinois Univ., Urbana.) *In its* Computational Fluid Dynamics Feb. 1992 p 225-234 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

Two approaches have been taken to provide systematic grid manipulation for improved grid quality. One is the control point form (CPF) of algebraic grid generation. It provides explicit control of the physical grid shape and grid spacing through the movement of the control points. It works well in the interactive computer graphics environment and hence can be a good candidate for integration with other emerging technologies. The other approach is grid adaptation using a numerical mapping between the physical space and a parametric space. Grid adaptation is achieved by modifying the mapping functions through the effects of grid control sources. The adaptation process can be repeated in a cyclic manner if satisfactory results are not achieved after a single application. Author

N92-25933*# Pratt and Whitney Aircraft, East Hartford, CT.
COMPUTATIONAL STRUCTURAL ANALYSIS AND ADVANCED COMMERCIAL ENGINES
R. B. Wilson *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 473-490 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

N92-25934*# Wright Lab., Wright-Patterson AFB, OH.
MILITARY ENGINE COMPUTATIONAL STRUCTURES TECHNOLOGY
Daniel E. Thomson *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 491-506 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N92-25401# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.
VIBRATION TESTS AND STRUCTURAL MODELING OF AN AIRCRAFT MODEL FOR ACTIVE CONTROL TECHNOLOGY EXPERIMENTS [ACT JIKKEN YO ZENKI DANSEI MOKEI NO SHINDO SHIKEN TO KOZO MODERU KA]
Kenji Fujii, Tetsuhiko Ueda, and Yasukatsu Ando Aug. 1990 23 p In JAPANESE
(NAL-TM-626; ISSN-0452-2982; JTN-92-80313) Avail: NTIS HC/MF A03

At the National Aerospace Laboratory (NAL), as a part of the research into an ACT (Active Control Technology) for an aerodynamic elastic system, gust load alleviation tests using aircraft elasticity models were performed in a large scale wind tunnel. This report describes the vibration tests of an aircraft elasticity model built for the ACT experiments. The model's main wing was constructed with elastic characteristics that are similar to the actual aircraft. The structural characteristics of the whole model, including the elastic deformation of the main wing, was studied using a mathematical model. The vibration tests were performed to study the structural dynamic characteristics of the model. The mathematical model for the elastic body was constructed using a finite element method based on test results. The control pattern was designed based on the intrinstic vibration frequencies and elastic deformation. Author (NASDA)

N92-25555 Arizona Univ., Tucson.
PREDICTION AND ANALYSIS OF WING FLUTTER AT TRANSONIC SPEEDS Ph.D. Thesis
Teng-Hua Shieh 1991 181 p
Avail: Univ. Microfilms Order No. DA9210300

This dissertation deals with the instability known as flutter, of the lifting and control surfaces of aircraft of advanced design at high altitudes and speeds. A simple model is used to represent the aerodynamics for flutter analysis of a two degree of freedom airfoil system. Flutter solutions of this airfoil system are shown to be algebraically homomorphic in that solutions about different elastic axes can be found by mapping them to those about the mid-chord. Algebraic expressions for the flutter speed and frequency are thus obtained. For prediction of flutter of a wing at transonic speeds, an accurate and efficient computer code is developed. The unique features of this code are the capability of accepting a steady mean flow regardless of its origin, a time dependent perturbation boundary condition for describing wing deformations on the wing surface, and a locally applied three dimensional far field boundary condition for minimizing wave reflections from numerical boundaries. Results for various test cases obtained using this code show good agreement with the experiments and other theories. Dissert. Abstr.

N92-25607*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MULTIFUNCTION TESTS OF A FREQUENCY DOMAIN BASED FLUTTER SUPPRESSION SYSTEM
David M. Christhilf (Lockheed Engineering and Sciences Co., Hampton, VA.) and William M. Adams, Jr. May 1992 12 p Presented at the Dynamics Specialists Conference, Dallas, TX, 16-17 Apr. 1992
(NASA-TM-107615; NAS 1.15:107615; AIAA-92-2096) Avail: NTIS HC/MF A03

The process is described of analysis, design, digital implementation, and subsonic testing of an active control flutter suppression system for a full span, free-to-roll wind tunnel model of an advanced fighter concept. The design technique uses a frequency domain representation of the plant and used optimization

techniques to generate a robust multi input/multi output controller. During testing in a fixed-in-roll configuration, simultaneous suppression of both symmetric and antisymmetric flutter was successfully shown. For a free-to-roll configuration, symmetric flutter was suppressed to the limit of the tunnel test envelope. During aggressive rolling maneuvers above the open-loop flutter boundary, simultaneous flutter suppression and maneuver load control were demonstrated. Finally, the flutter damping controller was reoptimized overnight during the test using combined experimental and analytical frequency domain data, resulting in improved stability robustness. Author

N92-25648*# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
APPLICATION OF NONLINEAR FEEDBACK CONTROL THEORY TO SUPERMANEUVERABLE AIRCRAFT Final Report, 21 Sep. 1988 - 21 Dec. 1991
William L. Garrard and Dale F. Enns 21 Dec. 1991 10 p
(Grant NAG1-821)
(NASA-CR-190336; NAS 1.26:190336) Avail: NTIS HC/MF A02

Controlled flight at extremely high angles of attack, far exceeding the stall angle, and/or at high angular rates is sometimes referred to as supermaneuvering flight. The objective was to examine methods for design of control laws for aircraft performing supermaneuvers. Since the equations which govern the motion of aircraft during supermaneuvers are nonlinear, this study concentrated on nonlinear control law design procedures. The two nonlinear techniques considered were Nonlinear Quadratic Regulator (NLQR) theory and nonlinear dynamic inversion. A conventional gain scheduled proportional plus integral (P + I) controller was also developed to serve as a baseline design typical of current control laws used in aircraft. A mathematical model of a generic supermaneuverable aircraft was developed from data obtained from the literature. A detailed computer simulation of the aircraft was also developed. This simulation allowed the flying of proposed supermaneuvers and was used to evaluate the performance of the control law designs and to generate linearized models of the aircraft at different flight conditions. Author

N92-25734*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
A PRELIMINARY LOOK AT AN OPTIMAL MULTIVARIABLE DESIGN FOR PROPULSION-ONLY FLIGHT CONTROL OF JET-TRANSPORT AIRCRAFT Final Report
Christopher P. Azzano (San Jose State Univ., CA.) Apr. 1992 55 p
(NASA-CR-186014; H-1729; NAS 1.26:186014) Avail: NTIS HC/MF A04

Control of a large jet transport aircraft without the use of conventional control surfaces was studied. Engine commands were used to attempt to recreate the forces and moments typically provided by the elevator, ailerons, and rudder. Necessary conditions for aircraft controllability were developed pertaining to aircraft configuration such as the number of engines and engine placement. An optimal linear quadratic regulator controller was developed for the Boeing 707-720, in particular, for regulation of its natural dynamic modes. The design used a method of assigning relative weights to the natural modes, i.e., phugoid and dutch roll, for a more intuitive selection of the cost function. A prototype pilot command interface was then integrated into the loop based on pseudorate command of both pitch and roll. Closed loop dynamics were evaluated first with a batch linear simulation and then with a real time high fidelity piloted simulation. The NASA research pilots assisted in evaluation of closed loop handling qualities for typical cruise and landing tasks. Recommendations for improvement on this preliminary study of optimal propulsion only flight control are provided. Author

N92-25982*# Systems Technology, Inc., Hawthorne, CA.
ASSESSMENT OF FLYING-QUALITY CRITERIA FOR AIR-BREATHING AEROSPACECRAFT
Duane T. McRuer, Thomas T. Myers, Roger H. Hoh, Irving L. Ashkenas, and Donald E. Johnston Washington NASA Jun. 1992 80 p Prepared for PRC Kentron, Inc., Edwards, CA
(Contracts NAS2-12722; ATD-88-STI-0221)
(NASA-CR-4442; H-1758; NAS 1.26:4442; STI-TR-2361-2) Avail: NTIS HC/MF A05

A study of flying quality requirements for air breathing aerospacecraft gives special emphasis to the unusual operational requirements and characteristics of these aircraft, including operation at hypersonic speed. The report considers distinguishing characteristics of these vehicles, including dynamic deficiencies and their implications for control. Particular emphasis is given to the interaction of the airframe and propulsion system, and the requirements for dynamic systems integration. Past operational missions are reviewed to define tasks and maneuvers to be considered for this class of aircraft. Areas of special concern with respect to vehicle dynamics and control are identified. Experience with the space shuttle orbiter is reviewed with respect to flight control system mechanization and flight experience in approach and landing flying qualities for the National Aerospace Plane (NASP). Author

N92-25599# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
DEVELOPMENT OF FLIGHT TESTING OF A FAULT TOLERANT FLY-BY-LIGHT YAW CONTROL SYSTEM [ENTWICKLUNG UND FLUGERPROBUNG EINES FEHLERTOLERANTEN FLY-BY-LIGHT GIERREGELUNGSSYSTEMS]
G. Mansfeld, K. Bender, and J. Tersteegen *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 154-176 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-25162*# Eloret Corp., Sunnyvale, CA.
EXPERIMENTAL INVESTIGATION OF NOZZLE/PLUME AERODYNAMICS AT HYPERSONIC SPEEDS Progress Research Report, 1 Apr. 1991 - 31 Jan. 1992
David W. Bogdanoff 16 Mar. 1992 16 p
(Contract NCC2-487)
(NASA-CR-190074; NAS 1.26:190074) Avail: NTIS HC/MF A03

An extensive program to improve the operation of the Ames 16 Inch Shock Tunnel was carried out. This included reduction of driver slosh wave amplitudes and detonation risk by the use of premixed He/O2 gas, longer wait times between the last gas load and driver gas ignition, an improved gas loading sequence, the use of four instead of one ignition wire, and the use of lower ignition wire voltages. Successful operation of the tunnel at pressures of 2000-6000 psi and enthalpies up to 12,000 J/gm was achieved. A new diaphragm breaking technique, self break on the driver combustion pressure rise, was tested and found to produce clean breaks over the full pressure range of the tunnel. Improvements were made to the driver gas loading manifold and a preliminary design was made of a gas mixing system which mixes all three gases on the fly just before injection into the driver. Other improvements as well as tests are discussed.
Author

N92-25191# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
ULTRA HIGH SPEED NUMERICAL WIND TUNNEL (UHSNWT) INITIATIVE AT NATIONAL AEROSPACE LABORATORY NUMERICAL SIMULATOR: SECOND GENERATION

Hajime Miyoshi May 1991 31 p In JAPANESE: ENGLISH summary
(NAL-TR-1108; ISSN-0389-4010) Avail: NTIS HC/MF A03

In order to promote computational fluid dynamics (CFD) research activities and effectively apply the results to the research and development of future aircraft and spaceplanes, it is necessary to develop within the next two or three years a CFD-oriented computer whose CFD processing speed is 100 times higher than the currently used Fujitsu VP400, and also to subsequently develop a computer more than 1000 times faster by the end of the 1990's. The requirements for the ultra high speed numerical wind tunnel (UHSNWT) are discussed from a perspective of development and operation costs, reliability, affinity with CFD programs, and operation environment. A National Aerospace Laboratory (NAL) UHSNWT initiative is proposed based on an operational vector computer, program processing software simulation of several vector computer configurations, and future trend forecasts of large scale integrated (LSI) circuit technology. It is concluded that developing the UHSNWT with a performance of more than 100 times higher than the VP400 is feasible using a parallel computer having a distributed memory and crossbar network. Author

N92-25365# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.
STUDY OF THE NAL'S 0.1 X 0.1 m MAGNETIC SUSPENSION AND BALANCE SYSTEM [0.1 METORU KAKERU 0.1 METORU JIRYOKU SHIJI SOCHI NO SHISAKU]
Hideo Sawada, Hiroshi Kanda, and Hisashi Suenaga Jun. 1990 20 p In JAPANESE
(NAL-TM-623; ISSN-0452-2982; JTN-92-80311) Avail: NTIS HC/MF A03

For wind tunnel tests where the model is supported inside the measuring unit, the support has to be constructed so that it will not disturb the flow field around the model. A magnetic suspension and balance system for a model was devised, as considerations on the interference from the support was not necessary. The magnetic support does not require any member inside the measuring unit and the air flow behind the model is not disturbed. First, basic structure and a brief history of the magnetic suspension and balance system is described. Then the actual design method of the 0.1 x 0.1 m magnetic suspension and balance system developed at NAL is presented. From test results of this system, the magnetic suspension and balance system circuit, power supply capacity, winding turns of the coil, and model location and inclination measuring sensor proved to be satisfactory. The improvement of measuring accuracy and control ability for the direction of y-axis and psi-axis are needed. Author (NASDA)

N92-25402# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.
THE FIBRE OPTIC THREE DIMENSIONAL LASER TWO FOCUS VELOCIMETER FOR THE LOW-SPEED WINDTUNNEL. PART 1: TWO-DIMENSIONAL MEASUREMENT EVALUATIONS
Shohei Takagi, Katsuichi Murota, Naoaki Kuwano, and Shigeo Kayaba Sep. 1990 33 p In JAPANESE; ENGLISH summary
(NAL-TM-627; ISSN-0452-2982; JTN-92-80314) Avail: NTIS HC/MF A03

A fiber optic three dimensional Laser Two Focus (L2F) Velocimeter was introduced in the Aircraft Aerodynamics Div. in 1988. The former half of the present report describes both an outline and the principle of this system for two dimensional measurements. In the latter half, the L2F Velocimeter is evaluated by using three types of flows, i.e., two dimensional wake, three dimensional boundary layer, and quasi two dimensional free jet with, and occasionally without, seeding particles. Furthermore, several seeding particles such as paraffine vapor, mosquito repellent smoke, and tobacco smoke are used for evaluations. The axial velocity component from the L2F Velocimeter is pointwisely compared with a calibrated velocity. The comparison is extended to the transverse mean velocity component and fluctuating components with hot-wire measurements, in which great care was taken with the linearity and wire inclination. There is no incongruity in comparison except in low turbulence with less than two percent intensity to the local velocity. In summary, features of the fiber optic L2F Velocimeter are its applicability to natural seed, wall proximity, and noncalibration measurements, although it is apriori known that the L2F Velocimeter is not adaptable to both reverse flow and high turbulence measurements.
Author (NASDA)

N92-25449*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ENGINE COMPONENT INSTRUMENTATION DEVELOPMENT FACILITY AT NASA LEWIS RESEARCH CENTER
Robert J. Bruckner, Alvin E. Buggele, and Jan Lepicovsky (Sverdrup Technology, Inc., Brook Park, OH.) 1992 10 p Proposed for presentation at the 17th Aerospace Ground Testing Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA
(NASA-TM-105644; E-6999; NAS 1.15:105644; AIAA-92-3995) Avail: NTIS HC/MF A02

The Engine Components Instrumentation Development Facility at NASA Lewis is a unique aeronautics facility dedicated to the development of innovative instrumentation for turbine engine component testing. Containing two separate wind tunnels, the facility is capable of simulating many flow conditions found in most turbine engine components. This facility's broad range of capabilities as well as its versatility provide an excellent location for the development of novel testing techniques. These capabilities thus allow a more efficient use of larger and more complex engine component test facilities. Author

N92-25733# Federal Aviation Administration, Atlantic City, NJ.
EVALUATION OF A TRITIUM RUNWAY LIGHTING SYSTEM
Eric S. Katz Apr. 1992 21 p Original contains color illustrations
(DOT/FAA/CT-TN92/15) Avail: NTIS HC/MF A03

A tritium powered runway lighting system was installed and evaluated at the FAA Technical Center. An attempt was made to determine if the tritium runway lighting system would safely support Federal Aviation Regulations (FAR) Part 135 commercial operations, during night time visual flight rules (VFR) conditions at remote airports. Subject pilots having flight experience levels appropriate for pilots conducting FAR Part 135 air taxi operations were afforded the opportunity of flight testing the system. Results of the evaluation indicate that the tritium runway lighting system does not meet all of the minimum criteria necessary for FAA approval and, therefore, would not guarantee an acceptable level of safety. Author

N92-25593# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
GROUND INSTALLATIONS FOR THE PREPARATION AND EVALUATION OF FLIGHT TESTS [BODENEINRICHTUNGEN ZUR VORBEREITUNG UND AUSWERTUNG VON FLUGVERSUCHEN]
G.-J. Barth *In its* Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 49-56 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N92-25178*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A PRELIMINARY STUDY OF THE SOVIET CIVIL SPACE PROGRAM. VOLUME 1: ORGANIZATION AND OPERATIONS
Elizabeth K. Newton Jun. 1990 96 p
(NASA-CR-190306; NAS 1.26:190306; JPL-D-7513) Avail: NTIS HC/MF A05

The organization, planning, and personnel is focused of Soviet

space, advantage is taken of glasnost and improved foreign relations to explore a hitherto obscure subject. The way in which the civil space program obtains approval and funding is altered. Missions must be approved before the Supreme Soviet, and public opinion is beginning to play a greater role in the legislature's budget decision. The Soviet civil space program remains a collection of disparate elements, not unified by any national, centralized space agency. An attempt was made to catalog and delineate the relationships between the components proves helpful. There is little or no coordination of independent associations' efforts, and the planning process relied on previously to set priorities and allocate resources appears to be currently inoperative or in a state of flux. The civil space program is moving in new directions: toward budget tautness, more international interactions, an emphasis on civilian over military applications, commercialization, and fiscal accountability. This study is a snapshot of a dynamic subject, but hopefully on which has highlighted the critical elements to track. Author

N92-25333# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE
20 Sep. 1991 94 p Transl. into ENGLISH from various Russian articles
(JPRS-USP-91-004) Avail: NTIS HC/MF A05

A bibliography of USSR space science and technology is given. Topics covered include manned mission highlights, spaceborne astronomy, space engineering, space applications, and space policy and administration. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-25617*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTONOMOUS RENDEZVOUS AND DOCKING CONFERENCE, VOLUME 2
1990 137 p Conference held in Houston, TX, 15-16 Aug. 1990
(NASA-TM-107857; JSC-24626; NAS 1.15:107857) Avail: NTIS HC/MF A07

Autonomous Rendezvous and Docking (ARD) will be a requirement for future space programs. Clear examples include satellite servicing, repair, recovery, and reboost in the near term, and the longer range lunar and planetary exploration programs. ARD will permit more aggressive unmanned space activities, while providing a valuable operational capability for manned missions. The purpose of the conference is to identify the technologies required for an on-orbit demonstration of ARD, assess the maturity of those technologies, and provide the necessary insight for a quality assessment of programmatic management, technical, schedule, and cost risks. Author

N92-26045*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTONOMOUS RENDEZVOUS AND DOCKING CONFERENCE, VOLUME 3
1990 301 p Conference held in Houston, TX, 15-16 Aug. 1990
(NASA-TM-107839; JSC-24626; NAS 1.15:107839) Avail: NTIS HC/MF A14

This document consists of the presentation submitted at the Autonomous Rendezvous and Docking (ARD) Conference. The document contains three volumes: ARD hardware technology; ARD software technology; and ARD operations. The purpose of this conference is to identify the technologies required for an on orbit demonstration of ARD, assess the maturity of these technologies, and provide the necessary insight for a quality assessment of programmatic management, technical, schedule, and cost risks. H.A.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N92-25197*# Cincinnati Electronics Corp., OH.
STUDY REPORT RECOMMENDATIONS FOR THE NEXT GENERATION RANGE SAFETY SYSTEM (RSS) INTEGRATED RECEIVER/DECODER (IRD)
Robert H. Crosby 27 Feb. 1992 127 p
(Contract NAS8-39160)
(NASA-CR-184321; NAS 1.26:184321) Avail: NTIS HC/MF A07

The Integrated Receiver/Decoder (IRD) currently used on the Space Shuttle was designed in the 1980 and prior time frame. Over the past 12 years, several parts have become obsolete or difficult to obtain. As directed by the Marshall Space Flight Center, a primary objective is to investigate updating the IRD design using the latest technology subsystems. To take advantage of experience with the current designs, an analysis of failures and a review of discrepancy reports, material review board actions, scrap, etc. are given. A recommended new design designated as the Advanced Receiver/Decoder (ARD) is presented. This design uses the latest technology components to simplify circuits, improve performance, reduce size and cost, and improve reliability. A self-test command is recommended that can improve and simplify operational procedures. Here, the new design is contrasted with the old. Possible simplification of the total Range Safety System is discussed, as is a single-step crypto technique that can improve and simplify operational procedures. Author

N92-26129*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TRANSONIC TURBINE BLADE CASCADE TESTING FACILITY
Vincent G. Verhoff, William P. Camperchioli, and Isaac Lopez 1992 13 p Presented at the 17th Aerospace Ground Testing Conference, Nashville, TN, 6-8 Jul. 1992; sponsored in part by AIAA
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-105646; E-7002; NAS 1.15:105646;
AVSCOM-TR-C-016; AIAA-92-4034) Avail: NTIS HC/MF A03

NASA LeRC has designed and constructed a new state-of-the-art test facility. This facility, the Transonic Turbine Blade Cascade, is used to evaluate the aerodynamics and heat transfer characteristics of blade geometries for future turbine applications. The facility's capabilities make it unique: no other facility of its kind can combine the high degree of airflow turning, infinitely adjustable incidence angle, and high transonic flow rates. The facility air supply and exhaust pressures are controllable to 16.5 psia and 2 psia, respectively. The inlet air temperatures are at ambient conditions. The facility is equipped with a programmable logic controller with a capacity of 128 input/output channels. The data acquisition system is capable of scanning up to 1750 channels per sec. This paper discusses in detail the capabilities of the facility, overall facility design, instrumentation used in the facility, and the data acquisition system. Actual research data is not discussed. Author

N92-25624# National Space Development Agency, Ohashi (Japan). ERS-1 Payload Ground Segment Office.
ERS-1 FACILITY AT EARTH OBSERVATION CENTER
Hiroyuki Wakabayashi *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 29-40 (For primary document see N92-25620 16-43)
(EW-4) Avail: NTIS HC/MF A08

N92-25627# Alaska Synthetic Aperature Radar Facility, Fairbanks.
ALASKA SAR FACILITY
John Miller *In* NASDA, International Conference on Japanese

Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 71-81 (For primary document see N92-25620 16-43)
(EW-7) Avail: NTIS HC/MF A08

N92-25628# Canada Centre for Remote Sensing, Ottawa (Ontario). Data Acquisition Div.
STATUS OF CANADIAN GROUND STATIONS
Leon Bronstein *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 83-90 (For primary document see N92-25620 16-43)
(EW-8(1)) Avail: NTIS HC/MF A08

N92-25631# National Research Council, Bangkok (Thailand).
JERS-1 WORKSHOP ON THE GROUND STATION FOR ASEAN
Chanchai Peanvijarnpong *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 101-11 (For primary document see N92-25620 16-43)
(EW-10) Avail: NTIS HC/MF A08

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N92-25958*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EXPERIMENTAL INVESTIGATION OF HIGH-ASPECT-RATIO COOLING PASSAGES
Julie A. Carlile and Richard J. Quentmeyer (Sverdrup Technology, Inc., Brook Park, OH.) 1992 13 p Proposed for presentation at the 28th Joint Propulsion Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-105679; E-6991; NAS 1.15:105679; AIAA-92-3154)
Avail: NTIS HC/MF A03

An experimental investigation was conducted to evaluate the effectiveness of using high-aspect-ratio cooling passenges to improve the life and reduce the colant pressure drop in high-pressure rocket thrust chambers. A plug-nozzle rocket-engine test apparatus was used to test two cylindrical chambers with low-aspect-ratio cooling passages and one with high-aspect-ratio cooling passages. The chambers were cyclically tested and data were taken over a wide range of coolant mass flows. The results showed that for the same coolant pressure drop, the hot-gas-side wall temperature of the high-aspect-ratio chamber was 30 percent lower than the baseline low-aspect-ratio chamber, resulting in no fatigue damage to the wall. The coolant pressure drop for the high-aspect-ratio chamber was reduced in increments to one-half that of the baseline chamber, by reducing the coolant mass flow, and still resulted in a reduction in the hot-gas-side wall temperature when compared to the low-aspect-ratio chambers. Author

N92-25240# Fiat Spazio, Rome (Italy).
THE CASE OF A SMALL LAUNCHER FOR ENVIRONMENTAL MISSIONS REQUIRING THE USE OF SMALL PAYLOADS
Giuseppe Grande *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 93-95 (For primary document see N92-25226 16-45)
Copyright Avail: NTIS HC/MF A07

N92-25780# Geophysical Observatory, Sodankyla (Finland).
MAGNETOMETRY USED IN ROCKET TESTS [MAGNETOMETRI RAKETTIKOKEISSA]
Aarne Ranta, J. Kultima, Heikki Ranta, M. Alatalo, and F. Primdahl (Danish Space Research Inst., Lyngby.) *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 49-50 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N92-25371# National Space Development Agency, Tokyo (Japan).
PREPRINTS OF NASDA'S 6TH TECHNICAL SYMPOSIUM [DAI 6 KAI UCHUU KAIHATSU JIGYOUDAN GIJUTSUSEIKA HAPPYOUKAI MAEZURISHUU]
5 Jun. 1991 101 p In JAPANESE Symposium held in Tokyo, Japan, 5 Jun. 1991 Submitted for publication
(JTN-92-80347) Avail: NTIS HC/MF A06

The following topics were discussed: spacelab, space station, space shuttle, payload specialist, crew training, JEM (Japanese Experiment Module), spacecraft modules, spacecraft structures, spacecraft design, manned orbital laboratories, OREX (Orbital Re-entry Experiment), reentry vehicle, hypersonic reentry, test vehicle design, Japanese spacecraft, FMPT (First Material Processing Test), HOPE (H-2 Orbiting Plane); aerodynamic heating characteristics, reentry effects, thermal protection, and reentry shielding. For individual titles, see N92-25372 through N92-25374.

N92-25372# National Space Development Agency, Tokyo (Japan). Space Station Program Dept.
PAYLOAD CREW TRAINING IN FUWATTO 1992 (FIRST MATERIAL PROCESSING TEST) PROJECT **c53**
Mamoru Mouri and Shigeki Kamigaichi *In its* Preprints of NASDA's 6th Technical Symposium 5 Jun. 1991 p 1-22 In JAPANESE; ENGLISH summary (For primary document see N92-25371 16-16)
Avail: NTIS HC/MF A06

The plan and the status of FUWATTO'92 payload crew training for Japanese payload specialist and NASA mission specialist is reported. NASDA (National Space Development Agency of Japan) is preparing for the FUWATTO'92, FMPT (First Material Processing Test) planned in September, 1992 in which the space experiments will be conducted on the Space Shuttle and Spacelab. Dr. Mamoru Mouri, Japanese payload specialist, will operate the space experiments on board. Author (NASDA)

N92-25373# National Space Development Agency, Tokyo (Japan). Space Station Group.
SPACE STATION PROGRAM AND PRELIMINARY DESIGN OF JEM **c18**
Kuniaki Shiraki *In its* Preprints of NASDA's 6th Technical Symposium 5 Jun. 1991 p 23-52 In JAPANESE; ENGLISH summary (For primary document see N92-25371 16-16)
Avail: NTIS HC/MF A06

In January 1990, the National Space Development Agency of Japan (NASDA) started the preliminary design of JEM (Japanese Experiment Module) as an element of the international space station Freedom program, and also started development test activities. NASA was asked by the U.S. Congress to restructure the space station Freedom program as a condition of 1991 budget approval. Restructuring activities were completed. This report provides the results of space station Freedom program restructuring as well as the status of JEM preliminary design.
Author (NASDA)

N92-25374# National Space Development Agency, Ibaraki (Japan).
DESIGN OF ORBITAL RE-ENTRY EXPERIMENT VEHICLE AND OUTLINE OF THE EXPERIMENT **c18**
Toshio Akimoto, Tomoyuki Kobayashi, Motoyuki Inaba, Tatsushi Izumi, and Isao Kawano *In its* Preprints of NASDA's 6th Technical Symposium 5 Jun. 1991 p 53-93 In JAPANESE; ENGLISH summary (For primary document see N92-25371 16-16)
Avail: NTIS HC/MF A06

The National Space Development Agency of Japan (NASDA)

plans an Orbital Re-entry Experiment (OREX) in the winter of 1993 as part of a study of the H-2 Orbiting Plane (HOPE). There are some critical technical subjects in developing HOPE. Especially, relating to atmospheric re-entry, critical items are estimating aerodynamic and aerodynamic heating characteristics of the vehicle in the hypersonic region, and developing heat-resistance materials and thermal protection systems. In order to acquire basic data about these items, OREX is planned. In this experiment, an experimental vehicle will be launched and inserted into orbit by the first flight of the H-2 Launch Vehicle, and re-enter into the atmosphere afterward. During atmospheric re-entry, data about aerodynamic heating, etc., will be acquired. Author (NASDA)

N92-25615*# TRW Space Technology Labs., Redondo Beach, CA. Federal Systems Div.
AEROBRAKE CONCEPTS FOR NTP SYSTEMS STUDY
Manuel I. Cruz Washington NASA Jun. 1992 81 p
(Contract NAS1-19291)
(NASA-CR-4441; NAS 1.26:4441) Avail: NTIS HC/MF A05

Design concepts are described for landing large spacecraft masses on the Mars surface in support of manned missions with interplanetary transportation using Nuclear Thermal Propulsion (NTP). Included are the mission and systems analyses, trade studies and sensitivity analyses, design analyses, technology assessment, and derived requirements to support this concept. The mission phases include the Mars de-orbit, entry, terminal descent, and terminal touchdown. The study focuses primarily on Mars surface delivery from orbit after Mars orbit insertion using an NTP. The requirements associated with delivery of logistical supplies, habitats, and other equipment on minimum energy Earth to Mars transfers are also addressed in a preliminary fashion.
Author

N92-26123*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
DEBRIS/ICE/TPS ASSESSMENT AND PHOTOGRAPHIC ANALYSIS FOR SHUTTLE MISSION STS-42
Gregory N. Katnik, Scott A. Higginbotham, and J. Bradley Davis Mar. 1992 109 p Original contains color illustrations
(NASA-TM-107542; NAS 1.15:107542) Avail: NTIS HC/MF A06; 54 functional color pages

A Debris/Ice/TPS (Thermal Protection System) assessment and photographic analysis was conducted for Shuttle Mission STS-42. Debris inspection of the flight elements and launch pad were performed before and after launch. Ice/frost conditions on the External Tank were assessed by the use of computer programs, nomographs, and infrared scanner data during cryogenic loading of the vehicle followed by on-pad visual inspection. High speed photography was analyzed after launch to identify ice/debris sources and evaluate potential vehicle damage and/or in-flighr anomalies. The debris/ice/TPS conditions are documented along with photographic analysis of Mission STS-42, and their overall effect on the Space Shuttle Program. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-25205*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRUCTURAL CHARACTERIZATION OF A FIRST-GENERATION ARTICULATED-TRUSS JOINT FOR SPACE CRANE APPLICATION
Thomas R. Sutter, K. Chauncey Wu, Kevin T. Riutort, Joseph B. Laufer, and James E. Phelps (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1992 23 p
(NASA-TM-4371; L-17061; NAS 1.15:4371) Avail: NTIS HC/MF A03

A first-generation space crane articulated-truss joint was statically and dynamically characterized in a configuration that approximated an operational environment. The articulated-truss joint was integrated into a test-bed for structural characterization. Static characterization was performed by applying known loads and measuring the corresponding deflections to obtain load-deflection curves. Dynamic characterization was performed using modal testing to experimentally determine the first six mode shapes, frequencies, and modal damping values. Static and dynamic characteristics were also determined for a reference truss that served as a characterization baseline. Load-deflection curves and experimental frequency response functions are presented for the reference truss and the articulated-truss joint mounted in the test-bed. The static and dynamic experimental results are compared with analytical predictions obtained from finite element analyses. Load-deflection response is also presented for one of the linear actuators used in the articulated-truss joint. Finally, an assessment is presented for the predictability of the truss hardware used in the reference truss and articulated-truss joint based upon hardware stiffness properties that were previously obtained during the Precision Segmented Reflector (PSR) Technology Development Program. Author

N92-25215# Lawrence Livermore National Lab., CA.
SPACECRAFT MICROPARTICLE IMPACT FLUX DEFINITION
D. Atkinson, A. Watts, and L. Crowell (POD Associates, Inc., Albuquerque, NM.) 30 Aug. 1991 120 p
(Contract W-7405-eng-48)
(DE92-009660; UCRL-CR-108788) Avail: NTIS HC/MF A06

The objectives of this work involve: the study of the space environment (micrometeoroid and man-made debris) which will apply to the anticipated orbits and mission periods of several possible systems, with the intent of specifying the probability of impacts, size distribution, composition of impactors, angles of impact, and the likely effects on unprotected optics, solar cells, star-trackers and other vulnerable components. Detailed studies have been made of the existing models describing the man-made debris and natural micrometeoroid environments. Based on these models, POD has developed a FORTRAN code to allow easy evaluation of the data. From these data POD has predicted the environment in terms of altitude, orbital inclination, and timeframe, and has identified the impact fluxes for each orthogonal spacecraft surface (i.e., RAM, SIDES, TRAIL, SPACE and EARTH facing). The data has been processed to allow correlations between impactors and the resulting impact damage: e.g., craters in ductile targets and starcracks in brittle targets, and perforations in thin-foil targets. The predictions of the model(s) are compared with experimental data from LDEF. The model allows predictions of the average degree of induced damage, giving the percentage of virgin area that will be subject to cratering etc. From these data it is possible to estimate the likely responses to the impact flux,

such as increases in optical scatter or vulnerabilities to atomic oxygen erosion. DOE

N92-25315# Sandia National Labs., Albuquerque, NM.
JOINT COMPUTATIONAL AND EXPERIMENTAL AERODYNAMICS RESEARCH ON A REENTRY VEHICLE
1991 9 p Presented at the AGARD Fluid Dynamics Panel Symposium on Theoretical and Experimental Methods in Hypersonic Flows, Torino, Italy, 5-7 May 1992
(Contract DE-AC04-76DP-00789)
(DE91-017315; SAND-91-1839C; CONF-920534-1-Ext-Abst)
Avail: NTIS HC/MF A02

This paper seeks to improve the synergism between computational aerodynamics and wind tunnel experimentation. In this paper, experimental and computational results are presented for a hypersonic vehicle configuration at Mach 8. Comparisons are made between experimental and computational results in order to improve the accuracy of both approaches. The basic vehicle configuration is a spherically blunted cone with a slice parallel with the axis of the vehicle. The half-angle of the cone is 10 degrees and the ratio of spherical nose radius to base radius in 10 percent. Onto the slice portion of the vehicle can be attached flaps with three different deflection angles; 10, 20, and 30 deg. All of the experimental results were obtained in the Sandia Mach 8 long duration, blow-down, hypersonic wind tunnel. Flow visualization results include surface oil flow, spark schlieren, and liquid crystal photographs and video. The liquid crystals were used as an aid in verifying that a laminar boundary layer existed over the entire body. An extensive uncertainty analysis was conducted to estimate quantitatively the accuracy of the measurement. Computational aerodynamic force and moment predictions are compared with the wind tunnel data. The Sandia parabolized Navier-Stokes code is used to generate solutions for the sliced vehicle (no flap) and partial solutions for the flapped vehicle. For the geometry with the flap, an axially separated flow occurs and a time iterative Navier-Stokes code is used to provide comparisons with the data. This paper presents a portion of the results given in earlier works and also discusses new experimental results with this configuration. DOE

N92-25382*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
FINAL DESIGN OF A SPACE DEBRIS REMOVAL SYSTEM
Erika Carlson, Steve Casali, Don Chambers, Garner Geissler, Andrew Lalich, Manfred Leipold, Richard Mach, John Parry, and Foley Weems 3 Dec. 1990 126 p
(Contract NASw-4435)
(NASA-CR-189976; NAS 1.26:189976) Avail: NTIS HC/MF A07

The objective is the removal of medium sized orbital debris in low Earth orbits. The design incorporates a transfer vehicle and a netting vehicle to capture the medium size debris. The system is based near an operational space station located at 28.5 degrees inclination and 400 km altitude. The system uses ground based tracking to determine the location of a satellite breakup or debris cloud. This data is unloaded to the transfer vehicle, and the transfer vehicle proceeds to rendezvous with the debris at a lower altitude parking orbit. Next, the netting vehicle is deployed, tracks the targeted debris, and captures it. After expending the available nets, the netting vehicle returns to the transfer vehicle for a new netting module and continues to capture more debris in the target area. Once all the netting modules are expended, the transfer vehicle returns to the space station's orbit, where it is resupplied with new netting modules from a space shuttle load. The new modules are launched by the shuttle from the ground, and the expended modules are taken back to Earth for removal of the captured debris, refueling, and repacking of the nets. Once the netting modules are refurbished, they are taken back into orbit for reuse. In a typical mission, the system has the ability to capture 50 pieces of orbital debris. One mission will take about six months. The system is designed to allow for a 30 degree inclination change on the outgoing and incoming trips of the transfer vehicle.
Author

N92-25393# RAND Corp., Santa Monica, CA.
ATTITUDE ORIENTATION CONTROL FOR A SPINNING SATELLITE
Gerald Frost 1991 24 p
(Contract F49620-91-C-0003)
(RAND/N-3250-AF) Avail: NTIS HC/MF A03

The Department of the Air Force, Headquarters Space Systems Division, and the National Aeronautics and Space Administration (NASA) are currently involved in litigation with Hughes Aircraft Company over the alledged infringement of the 'Williams patent,' which describes a method for attitude control of a spin-stabilized vehicle. Summarized here is pre-1960 RAND work on this subject and information obtained from RAND personnel knowledgeable on this subject. It was concluded that there is no RAND documentation that directly parallels the 'Williams patent' concept. Also, the TIROS II magnetic torque attitude control method is reviewed. The TIROS II meteorological satellite, launched on November 23, 1960, incorporated a magnetic actuation system for spin axis orientation control. The activation system was ground controlled to orient the satellite spin axis to obtain the desired pointing direction for optical and infrared sensor subsystems.
Author

N92-25442*# Alabama Univ., Huntsville.
SPECTRA, COMPOSITION, AND INTERACTIONS OF NUCLEI ABOVE 10 TeV USING MAGNET-INTERFEROMETRIC CHAMBERS Final Report, 1 Nov. 1990 - 20 Nov. 1991
J. C. Gregory and Y. Takahashi 1991 13 p
(NASA Order H-11203-D; NASA Order H-11286-D)
(NASA-CR-190316; NAS 1.26:190316) Avail: NTIS HC/MF A03

Although the SCIN-MAGIC experiment has, like all ASTROMAG and most other Attached Payload experiments, been 'deselected' from Space Station, it is expected that ultimately such emulsion chambers will be flown on the Station. Some brief studies are described which were made in support of the design efforts for such a program being conducted at NASA Marshall. Author

N92-25458# Technische Univ., Munich (Germany, F.R.).
CONTROLLABILITY INVESTIGATIONS OF A TWO-STAGE-TO-ORBIT VEHICLE
Bernd Kugelmann and Hans Josef Pesch 1991 17 p Presented at the AIAA Guidance, Navigation, and Control Conference, New Orleans, LA, 12-14 Aug. 1991 Sponsored by the German National Science Foundation
(Rept-3) Avail: NTIS HC/MF A03

For real-time computation of closed loop controls, guidance methods have been recently developed by the authors which are based on the theory of neighboring extremals and/or the multiple shooting algorithm. Because of their close relationship, these methods have a comparable domain of controllability, i.e., the set of all deviations from the nominal nominal optimal trajectory which can be compensated in real-time. Therefore, the multiple shooting method can be used to get an estimation for the size of these domains. In this way, the domain of controllability has been investigated for the payload maximum ascent of a two stage rocket propelled space vehicle from Earth into a circular target orbit. Here, the staging and the mass ratio of the two stages are optimized simultaneously. Author

N92-25828# European Space Agency, Paris (France).
FOURTH EUROPEAN SYMPOSIUM ON SPACE ENVIRONMENTAL CONTROL SYSTEMS, VOLUME 1
T.-Duc Guyenne, ed. and James J. Hunt, ed. Dec. 1991 560 p Symposium held in Florence, Italy, 21-24 Oct. 1991
(ESA-SP-324-Vol-1; ISBN-92-9092-138-2; ISSN-0379-6566; ETN-92-91355) Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Papers of the fourth European symposium on space environmental control systems covering activities in space thermal control, life support and habitability are presented. Subjects covered range from cryogenic cooling to reentry thermal protection systems, from atmosphere management to water and waste management

and from internal architecture to astronaut food selection. In volume 1 the following topics are particularly addressed: the International Space Station; heat transport systems; general ECLSS (Environmental Control and Life Support System); analytical tools (thermal); cryocoolers and refrigerators; thermal control systems; Columbus trace gas control and contamination; analytical tools (fluids); cryocoolers (very low temperatures); analyses, verification and testing; air revitalization and monitoring analytical tools (ECLSS); heat rejection; heat pipes and two phase technology. For individual titles, see N92-25829 through N92-25910.

N92-25829*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LIFE SUPPORT AND INTERNAL THERMAL CONTROL SYSTEM DESIGN FOR THE SPACE STATION FREEDOM
R. Humphries, K. Mitchell, J. Reuter, R. Carrasquillo, and B. Beverly (Boeing Co., Huntsville, AL.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 23-37 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A Review of the Space Station Freedom Environmental Control and Life Support System (ECLSS) as well as the Internal Thermal Control System (ITCS) design, including recent changes resulting from an activity to restructure the program, is provided. The development state of the original Space Station Freedom ECLSS through the restructured configuration is considered and the selection of regenerative subsystems for oxygen and water reclamation is addressed. A survey of the present ground development and verification program is given. ESA

N92-25830# Alenia Spazio S.p.A., Turin (Italy).
THE THERMAL/ENVIRONMENTAL SYSTEM DESIGN OF THE COLUMBUS PRESSURIZED MODULES
Ruggero Veneri, Burkhard Behrens, Hans Peter Leiseifer, and Aldo Petrivelli (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 39-44 (For primary document see N92-25828 16-18)
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The thermal/environmental design of the Columbus Attached Pressurized Module (APM), and Man Tended Free Flyer (MTFF) Pressurized Module (PM) is dealt with. The commonality aspects as well as the unique features are discussed. While a common design for the APM and MTFF thermal and environmental functions cannot be achieved due to different system constraints, a significant degree of commonality is possible at the component level. In addition, the MTFF is required to perform some tasks autonomously which, in the case of the APM, are delegated to the Space Station Manned Based (SSMB); two notable examples are the heat rejection by means of Body Mounted Radiators (BMR) and the trace gases contamination monitoring and control. ESA

N92-25831# National Space Development Agency, Tokyo (Japan).
PRELIMINARY DESIGN OF JEM ECLSS AND TCS
T. Suzuki, F. Otsuki, K. Suzuki, S. Shibutani, A. Hattori, H. Sasayama, M. Inoue, and W. Sugai (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 45-50 (For primary document see N92-25828 16-18)
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Preliminary design of the Japanese Module (JEM), which will be attached to the U.S. Space Station Freedom (SSF), began in early 1991. The target of the design activities is the Preliminary Design Review (PDR) planned in the beginning of 1992. The pressurized module of the JEM is composed of several subsystems including the Environmental Control and Life Support System (ECLSS), the Thermal Control System (TCS), mechanical equipment (airlock), the data management system, the communications and tracking system, the electrical power system, and the experiment support system. The preliminary design of ECLSS and TCS including the baseline configurations and the design requirements are described. ESA

N92-25832# Creare, Inc., Hanover, NH.
DESIGN METHODS, SCALING, AND MICROGRAVITY TESTING OF AN EXPERIMENTAL TWO-PHASE THERMAL SYSTEM **c29**
C. J. Crowley *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 53-60 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Experimental and analytical work related to the development of two phase heat transport systems for spacecraft for the U.S. Air Force is described. A two phase experimental system was constructed and flown aboard the NASA KC 135 aircraft. This represents one of few microgravity experiments involving a complete boiling and condensing cycle. The system experiment uses a unique design approach where shear (friction) forces and forced convection dominated flow regimes, pressure drop and heat transfer. The experimental system shows stable operation under variable gravity conditions from 0.01 to 2 g. In addition, a design manual and accompanying computer software were written for steady state two phase methods. These methods were used to design the components of this experimental system and to make several design calculations for the Space Station. While additional microgravity experiments are needed, the need for transient system analysis code is acute. ESA

N92-25833# National Aerospace Lab., Emmeloord (Netherlands). Space Div.
THERMAL GRAVITATIONAL MODELLING AND SCALING OF TWO-PHASE HEAT TRANSPORT SYSTEMS FOR SPACE: AN ASSESSMENT AND A COMPARISON OF PREDICTIONS AND EXPERIMENTAL RESULTS **c29**
A. A. M. Delil *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 61-67 (For primary document see N92-25828 16-18)
(Contract NIVR-2404-N)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Terrestrial scaling experiments using an ammonia test rig are foreseen to support the development of the ESA capillary pumped two phase ammonia experiment (TPX) in Get Away Special G-557 and the developmment of the mechanically pumped ESA R114 Two Phase Heat Transport System (TPHTS). The assessment of the applicability (validity and restrictions) of the modeling and scaling approach, based on similarity considerations, is supported by a comparison of measured two phase flow pressure drops under low gravity conditions and thermal gravitational modeling and scaling outcomes. ESA

N92-25834# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
TWO-PHASE THERMAL TECHNOLOGY FOR SPACE APPLICATION: DEVELOPMENT STATUS
H. G. Wulz and R. Siepmann *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 69-76 (For primary document see N92-25828 16-18)
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In 1983 a program to explore the necessity of two phase systems as highly efficient thermal control systems for future space projects was initiated. Now, after 8 years of development, a solid basis in the field of thermal technology has been reached. New thermal concepts such as two phase heat transport systems, heat pipes, thermal connectors and radiating systems have been developed and proven in comprehensive ground tests. The actual status of development of three main European two phase thermal technology programs is summarized. The objective of these projects

is to elaborate the technological basis for the development of new, most effective heat transport systems for future manned and unmanned spacecrafts. ESA

N92-25835# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

CAPILLARY-PUMPED HEAT TRANSPORT SYSTEM TWO-PHASE LOOP AND EVAPORATORS: RESEARCH AND RESULTS **c34**

S. VanOost, R. S. Bhatti, M. Dubois, G. Bekaert, and W. Supper (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 77-85 (For primary document see N92-25828 16-18)

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Different test performance and modeling results pertinent to capillary pumped heat transport systems are presented. The test results of an aluminum/ammonia two phase capillary pumped loop showed a heat transport capability between 250 W and 7.5 kW over a distance of 10 m. Emphasis is given to the loop in general and to the flat shaped evaporator performance. Cylindrical shaped evaporators tested on a simplified capillary pumped breadboard loop are considered. The comparative study for various designs is presented and discussed, emphasizing the thermal and hydraulic performance. Numerical thermal and hydraulic modelizations are compared with test results leading to the optimum evaporator design option. The evaporator designs used in the two phase ammonia experiment for TDP1 are shown. ESA

N92-25836# Academy of Sciences (USSR), Svierdlovsk. Inst. of Thermal Physics.

CAPILLARY-PUMP LOOP FOR THE SYSTEMS OF THERMAL REGULATION OF SPACECRAFT **c34**

Y. F. Maidanik, Y. G. Fershtater, and K. A. Goncharov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 87-92 Prepared in cooperation with Lavochkin Association, Khimky, USSR (For primary document see N92-25828 16-18)

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Capillary Pump Loops (CPL) are regarded as long term heat transfer devices for systems of thermoregulation of space vehicles. The use of high pressure capillary pumps ensuring pressures up to 50 kPa on low temperature heat transfer media makes it possible to create compact CPL with a high heat transfer capacity, which by their mounting characteristics approach electric cables. This is confirmed by the results of terrestrial tests of a prototype of CPL and also by flight tests of CPL aboard the space vehicle 'Granat'. ESA

N92-25837# MATRA Marconi Space, Toulouse (France).

FIRST RESULTS OF A FREON 12 CAPILLARY PUMPED LOOP **c34**

M. Feuillatre, T. Maciaszek, C. Butto, V. Platel, J. Y. Grandpeix, and O. Fudym (Toulouse Univ., France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 93-99 (For primary document see N92-25828 16-18)

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The design characteristics, the first experimental data and two thermal mathematical models (FLUINT and ZOOM) of a two phase Freon 12 capillary pumped loop are presented. This loop mainly consists of two parallel evaporators and isolators, one condenser, one reservoir (to control the loop temperature), two adiabatic pipes (one for liquid and one for vapor) and instrumentation. Different kinds of cylindrical evaporators were tested. The main design characteristics of these evaporators is an axially grooved profile with a polyethylene wick. Experimental performances obtained are encouraging (1800 Pa for the capillary pumped pressure with a 10 micron wick). Therefore, heat transport capability up to 750 kw/m can be envisioned for a similar ammonia loop. Up to 5000 w could be transported along an equivalent distance at 150 m (in a 20 mm straight vapor pipe at 20 C with a 10 micron wick, neglecting the condenser and liquid return pipe pressure drop). Such a loop, today in development, is also presented. ESA

N92-25838# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

EUROPEAN ECLSS TECHNOLOGY DEVELOPMENT RESULTS AND FURTHER ACTIVITIES **c54**

H. Funke, H. Preiss, S. Klingele, and G. Tan (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 103-111 Sponsored in part by ESA/ESTEC and DLR/BMFT (For primary document see N92-25828 16-18)

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In support of the Columbus IOC (Interorbit Communications) and EVA (Extravehicular Activity) ECLSS (Environment Control and Life Support System), a technology development program was performed on five items: regenerative CO2 removal; trace gas contamination control and monitoring; low noise variable speed fan; and fan/pump/water separator (EVA). The contents and results of the concluding subsystem level tests for the Columbus items and the assembly test results for the EVA fan/pump/water separator and consecutive program extensions are described. The present status of the development of an O2 reclamation system is pointed out. The scenario of ECLSS which will be necessary within the next decades are outlined. ESA

N92-25839# Hamilton Standard, Windsor Locks, CT.

ADVANCED REGENERATIVE LIFE SUPPORT FOR SPACE EXPLORATION **c54**

H. T. Couch, J. W. Auman, Jr., and T. C. Falvey *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 113-120 (For primary document see N92-25828 16-18)

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Advanced regenerative Environmental Control and Life Support System (ECLSS) technology was identified by NASA as enabling for space exploration. Low Earth Orbit (LEO) mass savings of over 700,000 pounds (320,000 kg) per year are expected for a lunar outpost crew of eight as compared with ECLSS systems which are currently flying. ECLSS technologies which show promise for reducing LEO mass for long range exploration initiatives are explored. The role of In Situ Resource Utilization (ISRU) and a Closed Ecological Life Support System (CELSS) are discussed. Physical-chemical candidates for advanced technological development are recommended based on combined expendable, consumable and installed subsystem LEO mass savings for a number of advanced water processing and air revitalization approaches. These processes include: higher efficiency urine processing with or without pretreatment; a single water processor for potable and hygiene water; obtaining potable water and oxygen from the electrolysis system; chemical N2 storage; and membrane gas separation processes. The benefits of these for increasing loop closure on N2, O2, and H2O are discussed. ESA

N92-25840# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).

ENGINEERING PROBLEMS OF INTEGRATED REGENERATIVE LIFE-SUPPORT SYSTEMS **c54**

N. M. Samsonov, N. S. Farafonov, O. P. Jakimenko, E. I. Grigorov, V. N. Kubasov, E. N. Zaitsev, I. V. Lavrov, and B. A. Adamovich (Institute of Biomedical Problems, Moscow, USSR) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 121-122 (For primary document see N92-25828 16-18)

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Some problems of the development and the principles of

construction of a complex of regenerative life support systems for space stations are dealt with. A structural schematic and the funtions of a complex aboard the Soviet manned Space Station Mir are described. The possibility of water and oxygen artificial turnover being realized at zero gravity is shown and some related engineering problems are outlined. The use of simulated mathematical models and checking of serviceability of systems as components of Earth based medical/engineering complexes are considered. ESA

N92-25841# Alenia Spazio S.p.A., Turin (Italy).
A COMBINED CABIN/AVIONICS AIR LOOP DESIGN FOR THE SPACE STATION LOGISTIC MODULE **c54**
Renato DAuria and Tiziano Malosti *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 123-127 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The Mini Pressurized Logistic Module (MPLM) is designed to transport cargo inside the Space Station Freedom. Results obtained from a preliminary design of the heat rejection and temperature control system are reported. Particular evidence is given to the combined cabin/avionics air loop design. This solution allows significant advantages to be gained in terms of mass, cost, control simplification, with respect to the more traditional approach which foresees separated cabin and avionics air loops. ESA

N92-25842# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ESA STANDARDISATION PROCESS THROUGH THE EXAMPLE OF MANNED SPACECRAFT ATMOSPHERES **c54**
C. Soulez-Lariviere and J. C. LePechon (JCLP Hyperbarie, Paris, France) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 129-131 (For primary document see N92-25828 16-18)
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Principles guiding the elaboration of ESA standards (PSS series) in the fields of ECLS (Environment Control and Life Support) and human factors (objectives, ECLS specification tree, applicability, preparation, approval) are detailed. This standardization work is performed within the life support and habitability section of ESTEC. Through the example of manned spacecraft atmospheres, the way standards values are selected and how, as recommended practices, these standards should be used to prepare ECLS subsystem design requirements for supporting the European Manned space Infrastructure is illustrated. ESA

N92-25843# Nelson Space Services Ltd., London (England).
ESA PSS-03-406: LIFE SUPPORT AND HABITABILITY MANUAL **c54**
R. C. Huttenbach and R. A. Binot (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 133-144 (For primary document see N92-25828 16-18)
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Some of the features of a reference manual to be issued as part of a set of standards covering the subjects of environmental control, life support, habitability and human factors are described. The manual contains information on the general requirements of life support and habitability and the missions that will drive its associated technologies. It is formatted as a series of individual data sheets that can be updated regularly and which are designed to accommodate inputs from other organizations and individuals working in this subject area. It also includes details of promising experimental studies and theoretical concepts, as well as historical reviews, that will help to guide the selection of technologies and the design of new systems. Examples drawn from the manual, which highlight critical aspects of a systems approach to life support design are presented. Practical tradeoff methods that can be used to evaluate competing technologies and their combinations at subsystem and systems level are also described. ESA

N92-25844# GEC Alsthom, Whetstone (England). Engineering Research Centre.
ESATAN: CURRENT STATUS AND FUTURE DEVELOPMENT
N. J. Stock, C. J. Kirtley, and C. J. M. Stroom (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 147-151 (For primary document see N92-25828 16-18)
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The ESA Thermal Analysis Network (ESATAN) software was first made available to users in August 1985. Since then it has replaced SINDA as the mainline thermal analysis tool in spacecraft developments for the ESA, and is the accepted standard for ESA projects. ESATAN is now in use at fifty sites throughout Europe. Over the six years since its release several major modifications to the system have been made, along with a multitude of detail changes. Updates and extensions are continuing to be made in response to user requests and developing computer technologies. The current status of the package is reviewed, explaining its development since the initial release in 1985. The current developments to the system and expected future direction are outlined. ESA

N92-25845# Swales and Associates, Beltsville, MD.
SPACECRAFT THERMAL ANALYSIS USING THE SIMPLIFIED SPACE PAYLOAD THERMAL ANALYZER (SSPTA)
Nicholas M. Teti *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 153-165 (For primary document see N92-25828 16-18)
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The Simplified Space Payload Thermal Analyzer1 (SSPTA) used in both government and industry for years in the thermal analysis and design of spacecraft and space hardware is considered. Technological advances in computer software during the last few years has provided the capability of developing a version of SSPTA that runs on a personal computer, called, SSPTA/386, without having to sacrifice performance. In fact, the development of SSPTA/386 led to an increase in performance of the SPTA subprograms as well as additional capabilities in the pre and post processing tools used in thermal analysis of spacecraft and space hardware. Details of the five SSPTA/386 subprograms are given and the enhancements made to improve geometric model generation and input file generation are addressed. ESA

N92-25846# GEC Alsthom, Whetstone (England). Engineering Research Centre.
ABLAT: ABLATION MODELLING EXTENSION TO THE ESATAN THERMAL ANALYSER
N. J. Stock, G. Singh, R. Bisanz, F. Zilly, and A. Lebru (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 167-172 (For primary document see N92-25828 16-18)
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The capabilities of the ABLAT software which is currently under development are discussed. The software is intended to provide an ablation modeling capability for the ESA Thermal Analysis Network (ESATAN) and consists of two sections: a stand alone preprocessor allowing specification of the ablation model, having both an X11/OSF Motif and a command line interface; an integrated solver capability within the ESATAN system, allowing transient analysis of an ablating surface in conjunction with a standard thermal model. Major aims of the development are reviewed. The software is discussed from two main points of view, the user

interface facilities (how the user defines the model to the system), and the calculation facilities (what can be calculated, and how are these calculations performed). ESA

N92-25847# GEC Alsthom, Whetstone (England). Engineering Research Centre.

ESARAD: THE EUROPEAN SPACE AGENCY'S RADIATIVE ANALYSER **c61**

J. J. Rebis, P. T. Warren, and P. Jeanne (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 173-178 (For primary document see N92-25828 16-18)

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ESARAD is an integrated suite of analysis tools for the calculation of view factors, radiative exchange factors and solar, albedo and planet heat fluxes. It will replace the VWHEAT software currently used by ESA subcontractors from the end of 1991. The software provides efficient capabilities in terms of: geometric modeling with the Constructive Solid Geometry (CSG) approach; calculation flexibility, speed and robustness, with guaranteed convergence; user friendliness based on a Graphical User Interface (GUI) and a high level input language; graphic representation of models using PHIGS; data storage (input models and simulation results) using the ORACLE database management system. The original aims of the ESARAD development are presented and how these were met by the product soon to be made available is looked into. ESA

N92-25848# MATRA Marconi Space, Toulouse (France).

COMPUTATION OF THERMAL RADIATION ON SPACECRAFT WITH MOBILE PARTS **c61**

P. Renard, E. Ajdari, and C. Puillet *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 179-186 (For primary document see N92-25828 16-18)

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For the computation of thermal radiation on spacecraft, a software, THERMICA, based on optimized Monte Carlo ray tracing techniques was developed. The 1.2 version of this software is presently distributed in Europe on VMS and UNIX machines, and contains significant improvements compared to its predecessor CBTS. The method used in THERMICA for the computation of radiative exchange factors and external fluxes, followed by its integration with the other modules for the computation on spacecraft with mobile parts, are presented. Two project applications illustrate the method: GLOBSAT/METOC (a space observatory of Earth environment) and SILEX (a satellite interlink experiment). In the first one the platform is Earth oriented and the solar array points towards the Sun. In the second one the platform is Earth oriented and the mobile part with two degrees of freedom tracks a geostationary satellite. In both cases, accurate modeling of shading effects and of variable radiative exchange factors was considered critical by the project and after the computation this was proven to be the case. ESA

N92-25849# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

MANAGEMENT OF VARIABLE GEOMETRY IN THERMAL ANALYSIS OF COMMUNICATION EQUIPMENT WITH ROTATING PARTS, PARTS 1 AND 2 **c61**

L. Borucki, E. Hanka, F. Zilly, H. Bachmann, and R. Seeliger (ANT Nachrichtentechnik, Backnang, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 187-192 (For primary document see N92-25828 16-18)

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Interorbit communication requires equipment moving relative to the spacecraft platform. A system of programs and procedures to solve the variable geometry problem making best use of existing programs and managing the large amount of data was developed. First a mission profile defines a set of pointing angles which are converted to intermediate coordinate systems definition for the moving parts. For each position of the profile radiative couplings and external radiation inputs are calculated, the results merged into two binary files which are used by SINDA to calculate actual radiation values by linear interpolation. This system was successfully used to analyze SILEX terminal (a laser instrument for interorbital communication) on SPOT4 (157 surfaces). CPU time and storage kept within acceptable limits. In view of future requirements ESABASE and European Space Agency Thermal Analysis Network (ESATAN) were implemented into the procedures. Examples are given showing different results for fixed and variable geometry. A detailed analysis was done for an optical terminal. Both systems can be applied to all problems which can be expressed in ICS modifications. ESA

N92-25850# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.

AN OVERVIEW OF ESA CRYOCOOLER ACTIVITIES **c31**

C. I. Jewell *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 195-199 (For primary document see N92-25828 16-18)

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With a significant number of future cryogenic cooling requirements incompatible with either radiative or cryogen cooling, a program of cryocooler developments which should lead to a range of 'space qualified' cryocoolers being commercially available for future users has been followed. An ESA 80 K 'Oxford type' cooler can presently be considered to be space qualified, while 20 and 4 K coolers are expected to be 'qualified' by 1992. Work is also being undertaken for the development of a 2.5 K cryocooler with 0.3 K as a future goal. The history of the 'Oxfordtype' cooler indicated that the design is based on an excellent pedigree and suggested future work should significantly increase the cryocoolers realm of applications. ESA

N92-25851# British Aerospace Public Ltd. Co., Bristol (England).

PRE-QUALIFICATION LEVEL TESTING OF AN 80 K STIRLING CYCLE COOLER **c31**

S. R. Scull and C. I. Jewell (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 201-207 (For primary document see N92-25828 16-18)

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The development and industrialization of a split Stirling cycle cooler for space applications capable of lifting 800 mW of heat at 80 K is considered. A cooler was manufactured as part of the first production batch and submitted to a prequalification level test program. Results of these tests which cover the following are presented: cooling performance, self induced vibration, launch vibration, electromagnetic compatibility, thermal vacuum tests, and life testing. ESA

N92-25852# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

A HEAT SWITCH FOR SPACE CRYOCOOLER APPLICATIONS **c33**

S. VanOost, G. Bekaert, R. S. Bhatti, S. Scull, and C. I. Jewell (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 209-216 (For primary document see N92-25828 16-18)

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A new passive cryogenic heat switch which is capable of thermally disconnecting a nonoperating cryocooler is considered.

The design uses the principle of an amplified differential contraction between two dissimilar materials with metal-metal contact and a flexible coupling. An on resistance of 3.64 K/W and an off resistance of greater than 2000 K/W was measured. The switching temperature can be easily adjusted but was set up to be approximately 150 K for the 80 K coolers used in this study. Thermal vacuum and shaker vibration tests are presented. ESA

N92-25853# Lucas Aerospace Ltd., Birmingham (England). Engine Systems Div.

THE DEVELOPMENT OF A RANGE OF LOW VIBRATION MECHANICAL CRYOCOOLERS FOR SPACE APPLICATION **c31**

Barry N. Hocking *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 217-221 (For primary document see N92-25828 16-18)

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The history of an aerospace split reversed Stirling cycle cryocooler from the initial evaluation of the design to the space qualificiation is traced. The main design features of the cryocooler and the electronic controller are discussed together with a description of the latter two phases of the program. Both the initial performance and exported vibration test results obtained during the phase 2 program and the various models developed during this phase are discussed. The latest test results from the current phase 3 space cryocooler program are discussed together with space qualification and future cryocooler programs. ESA

N92-25854# MATRA Marconi Space, Toulouse (France).

DESIGN OF A FREEZER SYSTEM FOR COLUMBUS **c31**

P. Vidal, A. Ravex, and J. C. Villard (L'Air Liquide, Sassenage, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 223-226 (For primary document see N92-25828 16-18)

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Refrigeration facilities are required to support life sciences experiments on the Columbus Space Station laboratories. Current freezers, achieving temperatures of about -20 C, are adequate for short mission times. Significantly lower temperatures, of the order of -80 C are required to avoid deterioration of specimens during the long mission times associated with Columbus utilization. A study which reviewed and traded available technologies to clearly identify and justify the choice of a freezer system providing cold storage at -20 and -80 C is presented. The design of the freezer system is then established and described. The technical solution is based on Dewar casing technology and Brayton cycle refrigeration. The Dewar technology ensures very low heat loads to the refrigeration machine and, therefore, a low overall power consumption. The Brayton cycle was chosen above all for its intrinsic microgravity compatibility. It also presents the high advantage of using nitrogen as heat carrier and of having low pressure ratios, which is a considerable safety bonus in a manned closed environment. ESA

N92-25855*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

A SURVEY OF SPACECRAFT THERMAL DESIGN SOLUTIONS

R. Humphries, R. Wegrich, E. Pierce, and W. Patterson *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 229-242 (For primary document see N92-25828 16-18)

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A number of thermal projects are outlined giving a perspective on the scope and depth of activities in the thermal control group. A set of designs are presented in a form to illustrate some of the more innovative work. Design configurations, solution techniques, and flight anomalies are discussed. Activities include the instruments of the Hubble Space Telescope, Space Station Freedom, and Spacelab. ESA

N92-25856# Alenia Spazio S.p.A., Turin (Italy).

HERMES THERMAL CONTROL CONCEPT

Antonio Moscatelli, Massimiliano Bottaccini, and Claudio Ferro *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 243-250 (For primary document see N92-25828 16-18)

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The Hermes Space Vehicle is made up of the reusable Hermes Spaceplane (HSP) itself and an expendable rear Hermes Resource Module (HRM). Both the HSP and HRM contain pressurized (habitable) compartments and unpressurized compartments. The complex configuration of the space vehicle and the mission profile require the adoption of a particularly flexible thermal control system which can satisfy the different requirements of the HSP and the HRM together with stringent safety and reliability requirements. All these aspects led to a thermal control design concept which uses active and passive means distributed through all compartments of the space vehicle. The ACTS (Active Thermal Control Section) is dedicated to the control of very high and concentrated thermal loads. It is based on a dual loop concept for heat collection (water and Freon R114 cooling loops), transportation and rejection through dedicated devicers. The PTCS (Passive Thermal Control Section) controls low heat fluxes spread on large surfaces. It relies on different concepts of insulation together with a system of temperature sensors and heaters, to control the thermal excursions of the space plane components and internal structural parts. ESA

N92-25857# Alenia Spazio S.p.A., Turin (Italy).

DESIGN AND COMMONALITY ASPECTS OF COLUMBUS PRESSURISED MODULES

Massimo Antonacci and Michele Trichilo *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 251-257 (For primary document see N92-25828 16-18)

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Columbus pressurized modules (Attached Pressurized Module (APM) permanently attached to the Space Station Freedom, and Man Tended Free Flyer-Pressurized Module (MTFF-PM)) will support scientific experiments and commercial space exploitation requiring either planned interaction and intervention (APM) or infrequent servicing/resupply by flight crew (MTFF-PM) in a low gravity environment. Based on the activities performed, the following are presented: the APM and MTFF-PM Temperature Control System/Subsystem (TCS/S) configuration; the commonality aspect at TCS/S and TCS/S components level; and the areas requiring further optimization from a commonality point of view. ESA

N92-25858# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

THERMAL CONTROL CONCEPT FOR THE CLUSTER SCIENTIFIC SATELLITE

Giacinto Gianfiglio, Han Scholten, and Wolfgang Pitz *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 259-264 Prepared in cooperation with Fokker Space and Systems, Amsterdam, Netherlands and Dornier System G.m.b.H., Friedrichshafen, Fed. Republic of Germany (For primary document see N92-25828 16-18)

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The Cluster Mission envisages an in situ investigation of the Earth's plasma environment using four identical spinning spacecraft flying simultaneously. The wide environmental scenario and the limited spacecraft resources are discussed as main drivers for the thermal control subsystem. The most suitable thermal design concept and required components/materials were selected. Subsequently, this thermal design concept was elaborated using a spacecraft level ESATAN (ESA Thermal Analysis Network) thermal mathematical model. The resulting performance is

illustrated giving particular emphasis to the operational procedures established to survive the few considerably long eclipses and to rapidly recover from those. A future outlook is given to the development and verification aspects. ESA

N92-25859# MATRA Marconi Space, Toulouse (France).
SOHO: A CHALLENGE IN SPACECRAFT THERMOELASTIC DESIGN AND VERIFICATION
P. Ayache, M. Cislaghi, K. Dummer, and S. Harvey (MATRA Marconi Space, England) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 265-271 (For primary document see N92-25828 16-18)
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An introduction to the mission purposes, the payload, and the main SOHO (Solar and Heliospheric Observatory) features is given and the key thermoelastic problem is addressed through the presentation of the very tight pointing requirements imposed by the experiments in the spacecraft structure, and through the description of the basic design aspects consequently chosen. The analytical verification aspects are addressed and some preliminary results obtained through ESATAN (ESA Thermal Analysis Network) modeling are presented. Design driving elements are identified and present criticalities and/or open points are discussed. ESA

N92-25860# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HUYGENS PROBE THERMAL ASPECTS
D. Wyn-Roberts, B. Patti, and K. Keller *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 273-277 (For primary document see N92-25828 16-18)
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The Huygens Probe thermal design has to cope with three main mission phases: several years of cruise/coast phase with considerable variations in the distance to the Sun; few minutes of high heat fluxes during entry in Titan's atmosphere; and some hours of descent in a very cold atmospheric environment. Several specific design solutions for similar first and second phase environments are already developed and experience from Earth based cryogenic applications contribute to the solution of the third phase. The challenge related to Huygens thermal control is to combine these different features and design options in a coherent solution which provides minimum mass combined with maximum reliability during all mission phases. To this end, the various design parameters are identified and the related sensitivies of the design options are analyzed. This includes consideration of appropriate thermal protection for entry thermal control where a tradeoff between mass and risk is presented. Based on the above steps, a design concept and its performance are given. In addition implications on system level are investigated. Hardware selection issues are addressed with mathematical modeling and verification methods concerning the descent phase. Some examples illustrate the design methods and assumptions used and, thus, substantiate the thermal performance predictions. ESA

N92-25861# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems.
SPECIAL HEAT TRANSFER PROBLEMS WITHIN THE HUYGENS PROBE
J. Doenecke and M. Elsner *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 279-283 (For primary document see N92-25828 16-18)
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During its 8.5 years flight to Saturn, the Cassini/Huygens spacecraft encounters severe hot and cold environmental conditions. Special heat transfer problems which occur during the 3 hour descent phase of the probe of Titan are addressed. Five equations are given for the natural convection in the probe. They consider different shapes, orientations, and flow regimes. The characteristic length in the equations for the Rayleigh number differs by a factor of about 20 when related to the main dimension. The cold gas of the atmosphere (70 to 200 K) enters first the upper enclosure through a hole and then the lower enclosure below the main platform. Two heat balance equations for the gas in these two enclosures are derived. Due to streamlining and mixing of gas the upper enclosure has equivalent cooling terms of -19 W and the gas in the lower enclosure has an equivalent heating of +6 W. ESA

N92-25862# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
TRACE GAS CONTAMINATION MANAGEMENT IN THE COLUMBUS MTFF **c54**
H. Abele and R. R. Lawson (Bowman Ltd., Bristol, England) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 287-294 (For primary document see N92-25828 16-18)
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The trace gas contamination management system for the Columbus Man Tended Free Flyer (MTFF) has to protect the crew from hazardous contamination of the module's atmosphere. This has to provide a set of hardware which is able to detect hazardous trace gases in the atmosphere and to control them below their Space Maximum Allowable Concentrations (SMAC). To achieve this goal, a system consisting of a monitoring assembly and a control assembly is proposed. A load model has to be established for the design of these assemblies. This model was determined by review of trace gas measurements and experiences of previous space missions coupled with the applicable requirements. ESA

N92-25863# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space System and Project Dept.
AN INNOVATIVE TECHNOLOGY FOR DETECTING AND MONITORING TRACE-GAS CONTAMINATION OF THE COLUMBUS FREE FLYER ATMOSPHERE **c54**
R. Stanyon and D. Zanotti *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 295-300 (For primary document see N92-25828 16-18)
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The development of an original technology for detection and recognition of trace gas contaminants in manned spacecraft atmospheres is described. Two different implementations of the same basic technology, both based on the principle of multiple sensors and pattern recognition, but utilizing different transducing methods and software concepts, are presented. Some of the experimental activities performed to demonstrate feasibility of this 'smart sensor' technology are described. In conclusion, the planning for future development (which includes a proposal for participation to the Columbus precursor flight program) is mentioned and potential free flyer applications identified. ESA

N92-25864# Bruker-Franzen Analytik G.m.b.H., Bremen (Germany, F.R.).
A GAS CHROMATOGRAPHIC SEPARATOR FOR COLUMBUS TRACE GAS CONTAMINATION MONITORING ASSEMBLY **c54**
J. Franzen, G. Baykut, H.-P. Vetters, G. Weiss, and H. Abele (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 301-305 (For primary document see N92-25828 16-18)
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A development model gas chromatographic separator was designed and built for the trace gas contamination monitoring assembly of the Columbus Man Tended Free Flyers (MTFF's) environmental control and life support system. Atmospheric contaminants in the free flying laboratory will be analyzed by a

gas chromatograph/mass spectrometer (GCMS). The gas chromatograph developed at this stage is compact, lightweight, low power consuming, and fast operating. It can easily be connected to the mass spectrometer, and its separation performance is very good for GCMS analysis. ESA

N92-25865# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SELECTION OF AN OPTIMISED HIGH TEMPERATURE CATALYST FOR ATMOSPHERE TRACE CONTAMINANT CONTROL **c54**
J. Witt, D. deChambure, and K. Ammann (Draegerwerk A.G., Luebeck, Germany, F.R.) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 307-311 (For primary document see N92-25828 16-18)
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Test were carried out in a life support unit with the goal to identify an optimized catalyst for the oxidation of methane and other hydrocarbons. Such a catalyst might be used in the life support system of the Columbus Free Flying Laboratory. Optimization parameters were: high conversion at low reaction temperature, lifetime, and resistance of catalyst poisoning and vibration. For the testprograms, eleven catalyst samples were obtained and subjected to performance screening, vibration, and poisoning tests. A monolithic catalyst performed best in all tests. ESA

N92-25866# Draegerwerk A.G., Luebeck (Germany, F.R.).
INVESTIGATION OF CATALYSTS FOR THE REMOVAL OF CARBON MONOXIDE AND HYDROGEN FROM AIR **c54**
K. Ammann, H. Heyer, S. Haupt, and A. Exner (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 313-316 (For primary document see N92-25828 16-18)
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A catalyst screening program was conducted to optimize the low temperature catalyst of the environmental control and life support system of space stations. The activity of the catalysts for the oxidation of carbon monoxide and hydrogren in air was measured in a laboratory setup in dependence on temperature, test gas composition, flow, pretreatment, and humidity. Eighteen noble metal catalysts of various manufacturers were tested. Humidity had a large influence on the long term stability of the catalysts. Not all catalysts showed sufficient resistance to humid air. ESA

N92-25867# Draegerwerk A.G., Luebeck (Germany, F.R.).
BREADBOARDING OF THE MAIN CHARCOAL FILTER: A COMPONENT OF THE TRACE GAS CONTAMINATION CONTROL ASSEMBLY FOR THE MTFF **c54**
H. Heyer, H. Abele, K. Ammann, and R. Lawson (Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 317-322 (For primary document see N92-25828 16-18)
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A breadboard model of a charcoal filter which is designed to remove a wide variety of organic vapors from the Space Station atmosphere by physical adsorption is described. The contaminants occurring in the Space Station's atmosphere are represented by 16 substances. Adsorption isotherms for the substances are determined in the range 0.9 to 0.001 of the saturated vapor. In a chamber, the contaminant amount generated during 180 days is simulated, and with the charcoal filter operating, equilibrium concentrations for the contaminants are determined. The influence of relative humidity on the equilibrium concentration is investigated in the range of 25 to 75 percent. Out of the 16 substances, only dichlorometane exceeds the spacecraft maximum allowable concentration at 75 percent relative humidity. ESA

N92-25868# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
TRACE GAS MONITORING STRATEGIES FOR MANNED SPACE MISSIONS **c54**
S. Klingele and G. Tan (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 323-328 (For primary document see N92-25828 16-18)
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Intermediate results of a study to identify trace gas monitoring needs, monitoring strategies, and suitable equipment for manned future space missions are reported. The identification of standardized space mission types is based on a comprehensive literature review. Each strategy is detailed by an example list of compounds, which are to be measured qualitatively and quantitatively. A selection of suitable monitoring equipment for each space mission type is foreseen, based on the list of compounds to be monitored within each strategy. A market screening of currently available measurement technology is performed, and an outlook on first preliminary results of the technology tradeoff is given. ESA

N92-25869# Alenia Spazio S.p.A., Turin (Italy).
THERMO-HYDRAULIC SIMULATION AND REGULATION OF ACTIVE THERMAL CONTROL USING ESACAP SOFTWARE
D. Nikanpour, F. Ciampolini, and P. Stangerup (Danish Research Center for Applied Electronics, Hoersholm.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 331-339 (For primary document see N92-25828 16-18)
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The use of personal computer based ESACAP as a simulation tool applied to space based active thermal control systems is addressed. ESACAP is a general purpose simulation program, primarily designed for the analysis of electrical and thermal systems with the modeling done by use of a flexible description language. The submodel macrofacility and dedicated decoding subroutines have allowed the development of basic thermohydraulic components as building blocks for the set up of more detailed models. The implementation of the submodels in a typical pumped single phase fluid loop system including the regulation loop are discussed along with optimization of control valve characteristics. ESA

N92-25870# Aerospatiale, Cannes (France). Div. des Systemes Strategiques.
FLUIDNET-G: A GRAPHIC SOFTWARE FOR THE PRELIMINARY SIZING OF FLUID LOOPS NETWORKS **c61**
J. N. Chelotti, S. Andre, T. Maciaszek, A. Thuaire, and A. Ferro (Societe Regionale d'Informatique Industrielle, Valbonne, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 341-347 Sponsored by CNES (For primary document see N92-25828 16-18)
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FLUIDNET-G, a workstation, enhanced graphic, software package is considered. FLUIDNET-G is designed as an integrated software package to perform the following functions: interactive input of fluid loop schematics ('mouse-icon' driven); schematic handling (display, modification, delete); translation from 'graphic objects' to input 'network database'; thermal and hydraulical solving of fluid loops; display of results; and hard copy of schematics and results. ESA

N92-25871# GEC Alsthom, Whetstone (England). Engineering Research Centre.
FHTS: ACTIVE THERMAL CONTROL ANALYSER VERIFICATION, VALIDATION, AND UPGRADE **c61**
C. J. Kirtley, Y. Boillot, and A. Lebru (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 349-356 (For primary document see N92-25828 16-18)
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The Fluid Heat Transport System (FHTS) is a major extension to the existing ESATAN (ESA Thermal Analysis Network). It is capable of carrying out one dimensional steady state or transient analysis, solving for pressure, temperature, and mass flow rate, for single or two phase loops. An overview of the capabilities of FHTS is given and the stringent quality assurance standards adhered to during its development are outlined. The coding standards ensure software verification during its development via module testing and the development of a test suite. Further verification of both the single phase and two phase capability has already been carried out by comparison against Retran, a well established package used throughout the nuclear industry. A first step in validating FHTS was carried out for the single phase package by comparing experimental data against simulated results. To achieve this goal, the hybrid radiator under development in the frame of the Columbus program was used. The experimental data was taken from the final thermal vacuum test. The validation work proved conclusive. The first major upgrade of the software is currently underway. A detailed account of the work carried out up to date and the work remaining is given. ESA

N92-25872# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
FIRST EXPERIENCE WITH FHTS APPLICATION FOR SYSTEM ANALYSIS (COLUMBUS MTFF) AND COMPONENT DEVELOPMENT (HERMES WEA) **c61**
M. Gralher, B. Haase, and G. Kleinert-Alvarado *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 357-371 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany (For primary document see N92-25828 16-18)
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The Fluid Heat Transport System (FHTS) is a major extension of ESATAN (ESA Thermal Analysis Network). Initial investigations with FHTS were made in the domains of thermodynamics and hydraulics by the analysis of the cooling system of the Columbus Man Tended Free Flyer (MTFF) and for the component development of the Water Evaporator Assembly (WEA) of the Hermes Spaceplane. The cooling system of the MTFF consists of liquid and gas cooling loops, which are connected by heat exchangers. The analysis of the transient system behavior was performed in two independent methods; one without the consideration of hydraulic parameters under the usage of ESATAN as well as with the inclusion of hydraulic parameters under the usage of FHTS. The development of both models, differing results, and problems which occurred during the simulation are shown. The problems which occurred during analyses, such as large required node numbers and high CPU times, are also dealt with. ESA

N92-25873# Centre National d'Etudes Spatiales, Toulouse (France).
PRESENTATION OF CEDRIC: COMPARISON WITH OTHER CODES FOR SINGLE PHASE ANALYSIS **c61**
Thierry Maciaszek, Joel Gayrard, and Gilles Barges (Commissariat a l'Energie Atomique, Aix-en-Provence, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 373-380 (For primary document see N92-25828 16-18)
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CEDRIC (French Acronym for interconnected network dynamics code) is presented. CEDRIC is a one dimensional thermalhydraulic code which is capable of modeling single and two phase flow for steady state and transient conditions. It was developed for nuclear cooling system design and failure analysis. It is a '3+1' equations code (mass, momentum, energy in fluid, and energy in walls linked to fluid). These equations are solved by a fully implicit resolution method. In order to fulfil the requirements of spaceborne fluid loop analysis some adaptations such as new fluids and new elements (radiators for example) were required. CEDRIC is able to handle many space thermal hydraulic problems and particularly the complete Hermes active thermal control subsystem. Comparisons between CEDRIC, FHTS (Fluid Heat Transport System), FLUIDNET and ESATAN (ESA Thermal Analysis Network) for different single phase applications (only for thermal aspects with ESATAN, and only for steady state analysis with FLUIDNET) are presented. Calculation/measurement comparisons of experimental results are also presented. ESA

N92-25874# Tsukuba Space Center, Ibaragi (Japan).
ANALYTICAL APPROACH TO MODULATION AND CONTROL OF PUMPED LIQUID LOOPS **c34**
Masao Furukawa *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 381-389 (For primary document see N92-25828 16-18)
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As a common basis for analyses and computations, practical expressions on thermophysical properties of ten kinds of compressed liquids of concern are presented. All the analyses were made in dimensionless forms so as to offer more general expressions helpful in design practices of fluid loop controllers. Three kinds of control laws for a standard loop consisting of a cold plate, a space radiator, and a pump, are considered together with six kinds of control laws for two loops coupled with a heat exchanger of counterflow type. Their methods of control are either pump speed or bypass flow rate modulation. Off design operation problems of a pumped liquid system are solved to give modulation rates which permit maintaining the cold plate temperature at a specified value. Laplace images of transfer functions of a cold plate to step inlet temperature, step heat rate, and step flow rate and those of a space radiator to such step ones are also presented. They are expressed in rational functions with coefficients of which the reference values can theoretically be determined. Correction factors to them are listed as a result of numerical simulations. ESA

N92-25875# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
DEVELOPMENT OF CRYOCOOLERS FOR SPACE APPLICATIONS USING HYDRODYNAMIC GAS BEARINGS **c31**
G. Claudet, L. Duband, A. Ravex, and P. Rolland *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 393-396 Sponsored by CNES and DGA (For primary document see N92-25828 16-18)
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A development program of cryocoolers for space applications is currently in progress. The main feature is the use of hydrodynamic gas bearings. Functional mockups were built to characterize and demonstrate the feasibility of the concept. Presizing and optimization of the development model of a Vuilleumier engine was done. A first thermal compressor with a warm bearing (1000K) was built and operated. New components including a thermal compressor and a cold expander with room temperature bearings and linear actuator are under construction, or tests. A Stirling engine is also under development. A twin piston balanced pressure oscillator and a double staged cold expander were designed and are in a machining phase. ESA

N92-25876# Rutherford Appleton Lab., Chilton (England).
A CLOSED CYCLE 4 K MECHANICAL COOLER FOR SPACE APPLICATIONS **c31**
T. W. Bradshaw and A. H. Orlowska *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 397-401 (For primary document see N92-25828 16-18)
(Contracts ESA-6342/85/ML/PB(SC); ESA-7198/87/NL/MA(SC))
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A closed cycle 4 K mechanical cooler suitable for applications in space was developed. The cooler consists of a Stirling cycle cooler at approximately 25 K which precools a closed cycle Joule-Thomson (JT) system. The technology was developed from the successful single stage Stirling cycle cooler. The cooler is described and the first results are discussed. ESA

N92-25877# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.
A NEW He-3 REFRIGERATOR FOR SPACE APPLICATIONS **c31**
C. I. Jewell, G. DallOglio, W. Fischer, L. Piccirillo, and L. Pizzo (Rome Univ., Italy) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 403-405 (For primary document see N92-25828 16-18)
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Helium three (He-3) refrigerators capable of reaching 0.3 K in space with liquid helium cryogen cooling stages at approximately 1.8 K were already developed to the point of being tested on sounding rockets. A new design of He-3 refrigerator incorporating an additional closed cycle He-4 stage, which operates with the precooler at 4 K, is described and evaluated for its potential with respect to space applications. The use of such a He-3 refrigerator coupled to a 4 K cryocooler is discussed, with the suggested possibility of long life (several years) microwatt cooling at 0.3 K, for a spacecraft system level cost which is expected to be less than 50 kilograms and 200 Watts of power input. ESA

N92-25878# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
A MINIATURE ADSORPTION He-3 REFRIGERATOR **c31**
L. Duband, A. Lange (California Univ., Berkeley.), and A. Ravex *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 407-409 (For primary document see N92-25828 16-18)
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A self contained, recyclable, laboratory He-3 refrigerator is considered. The refrigerator is very compact, portable, and is designed to be safe and reliable. The unit can easily be installed in the cold plate of a superfluid He-4 cryostat. Once bolted to the cold plate, operation of the refrigerator is controlled by a single heater. In this new design the refrigerator has a cylindrical geometry. The adsorption pump is placed above the condensation point to prevent convection during the condensation phase and to improve the pumping speed. The inhibition of convection reduces the load in the He-4 bath and increases the condensation efficiency. This refrigeration technique has great potential for space applications. The absence of moving parts makes the system reliable and vibration free. Its simplicity and the absence of external components facilitate its integration on a cryostat. A rocketborne He-3 refrigerator was successfully flown and demonstrated the feasibility of this method. An orbital refrigerator that can be recycled in zero gravity was developed and is being integrated in the Infrared Telescope in Space (IRTS). ESA

N92-25879# British Aerospace Public Ltd. Co., Bristol (England).
DEVELOPMENT AND PRE-QUALIFICATION TESTING OF A 20 K SPACE COOLER **c31**
B. G. Jones, T. W. Bradshaw, A. H. Orlowska, and C. I. Jewell (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 411-416 (For primary document see N92-25828 16-18)
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During the successful Stirling Cycle 80 K cooler development program, the design of which was based upon the technology of diaphragm support springs and clearance seals, the need for lower temperature cryogenic cooling was identified. It was considered achievable via a modification of the 80 K cooler design. This modification led to a linear dual stage split Stirling cycle cooler fedvia two compressors. The long life pedigree of the 80 K cooler was retained, while the base temperature was lowered to less than 20 K. The background of development is presented together with test results. The major part of the discussion centers on a joint activity to manufacture a cooler, and test it to prequalification environmental levels. ESA

N92-25880# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems.
ISO-PLM TEST EVALUATION WITH THERMOPT
Martin Sander *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 417-422 (For primary document see N92-25828 16-18)
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In 1990 the STM (Structural/Thermal Model) of the ISO PLM (Infrared Space Observatory PayLoad Module) underwent testing in laboratory and thermal vacuum environment, with both tests ending in steady state conditions. Work performed in the PLM thermal model in order to correlate its results to the test data measured is reported. The (newly developed) optimizer program THERMOPT was used to help the adjusting. The program and its interface to the ESA Thermal Analysis Network (ESATAN) model of ISO are described and the findings after a set of 39 optimizer runs are given. Having used a reduced ESATAN model for this part of work the correlation results were introduced into the big ISO thermal model and the new lifetime was assessed to a value of approximately 664 days, well beyond the 548 days required. ESA

N92-25881# Alenia Spazio S.p.A., Turin (Italy).
A SYSTEMATIC APPROACH TO THERMAL BALANCE TEST EVALUATION AND THERMAL MATHEMATICAL MODEL CORRELATION FOR SPACECRAFT THERMAL DESIGN
Lazzaro Costamagna, Valter Perotto, and Enrico Sacchi *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 425-431 (For primary document see N92-25828 16-18)
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A Thermal Balance Test (TBT) definition, performance, and result evaluation, in the frame of the thermal design verification activities is presented. It is based on the test and correlation performed for the following projects: Sirio, Olympus, Iris, Italsat, Eutelsat 2, Eureca , Tethered, and SAX. Some flight data is also presented and discussed. ESA

N92-25882# Central Research Inst. of Tech. and Machine Building, Moscow (USSR).
ACCURACY REQUIREMENTS FOR ENVIRONMENTAL HEAT FLUXES SIMULATION AT SPACECRAFT THERMAL VACUUM TESTING
N. A. Anfimov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 433-438 (For primary document see N92-25828 16-18)
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A method of error analysis is suggested for environmental heat flux of a spacecraft surface. The method is based on local

examination of stationary thermal conditions at the spacecraft shell element with limited thermal resistance. Various coefficients are introduced; they characterize relations between environmental heat flux errors and spacecraft interior temperature errors. Analytical expressions and graphic dependencies for those coefficients are obtained. The method suggested is applied to the analysis of spacecraft thermal conditions errors, which are connected with mean heat fluxes errors and with spatial uniformity of heat fluxes in test facilities. ESA

N92-25883# Alenia Spazio S.p.A., Turin (Italy).
VERIFICATION APPROACH FOR THE THERMAL CONTROL OF MANNED SPACE SYSTEMS: COLUMBUS AND HERMES
Salvatore Tavera, Paolo Balocco, and Pietro Ladisa *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 439-446 (For primary document see N92-25828 16-18)
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Among the space programs presently under development in Europe are Columbus and Hermes. Both require the presence of a crew on board; the stringent safety requirements heavily affect the design and drive the definition of the verification approach for the whole system, and in particular for the thermal control subsystem, which is subdivided into two sections: Active Thermal Control Subsystem (ATCS) and Passive Thermal Control Subsystem (PTCS). The verification of any thermal control system cannot rely on analysis only. Hence an extensive thermal test campaign is required at the subsystem and the system level. The traditional solar simulation/thermal balance test in vaccum, commonly adopted as the final (and sometimes unique) experimental verification for new design spacecraft, is not applicable to Columbus and Hermes for technical and cost reasons. An overview of the thermal control verification philosophy and test program of the systems are presented on a comparative basis. ESA

N92-25884# Alenia Spazio S.p.A., Turin (Italy).
THERMAL MATHEMATICAL MODELLING PHILOSOPHY FOR MODULAR AND INTEGRATED NETWORKS USED IN THE HERMES THERMAL CONTROL
Pierluigi Petrini, Renato Martino, and Giuseppe Ruvolo *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 447-453 (For primary document see N92-25828 16-18)
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The management of thermal modeling activities, so as to build up an overall Hermes Thermal Mathematical Model (HTMM), is described. This overall thermal model is developed using ESATAN (ESA Thermal Analysis Network) software. This computer code allows the hierarchical linking of the various 'stand alone' submodels of different compartments of the Spaceplane. In the Hermes program these submodels are built and run independently, and to permit a successful integration some key points must be considered: requirements for submodel/compartment development; interface definition between submodels; boundary conditions for each submodel; consistent thermal parameters database; network change facilities; logic implementation to simulate the mission phases to be analyzed; linking of submodels; requirements for post processing; and result interpretation. These aspects are discussed, underlining the major problems encountered and the solutions adopted. ESA

N92-25885# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
RADIATION PROPERTIES OF THE LARGE SPACE SIMULATOR: INVESTIGATION OF THERMAL BACKGROUND RADIATION AND RESULTS OF SPECTRAL MEASUREMENTS
D. Stramaccioni, M. N. DeParolis, and N. Nikolaizig *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 455-462 (For primary document see N92-25828 16-18)
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A thermal analysis based on a complete geometrical model of the Large Space Simulator (LSS) interior was performed to provide the user with a clear picture of the facility's thermal environment and to prepare a specific mathematical tool (a LSS reduced Model) which can be used for pretest prediction and posttest correlation activities. The complex geometry of the facility and the boundary temperatures of its various elements were modeled with various levels of accuracy. The effects of the solar beam multireflections inside the chamber were also taken into account. The resultant thermal environments were mathematically evaluated by means of test surfaces simulating test articles. Beyond that, extensive measurements were performed to characterize the LSS Sun simulator spectrum. The potential impacts of cumulative lamp operating time and lamp electrical power on spectral distribution were studied. ESA

N92-25886# Institut fuer Kosmosforschung, Berlin (Germany, F.R.).
ESTIMATION METHODS OF HEAT EXCHANGE PARAMETERS BY TRANSIENTLY MEASURED TEMPERATURES **c34**
B. Biering and F. Lura *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 463-466 (For primary document see N92-25828 16-18)
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A method for the identification of the exchange parameters in a space simulation chamber is described. The method involves a Kalman filter algorithm and the transient measurement of temperature. Preliminary results are unsatifactory, and possible causes for this are discussed. ESA

N92-25887# Oesterreichische Raumfahrt- und Systemtechnik, Vienna (Austria).
CARBON DIOXIDE REDUCTION SYSTEM AS PART OF AN AIR REVITALIZATION SYSTEM **c54**
K. Sperker and G. Tan (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 469-472 (For primary document see N92-25828 16-18)
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To meet the challenge of European long term manned missions on board a permanently orbiting space infrastructure, an Environmental Control and Life Support (ECLS) technology is to be developed. Limited to the spacecraft atmosphere management system, the ultimate goal is to close the airloop by processing the metabolically produced carbon dioxide, and reclaiming the oxygen from onboard resources to eliminate the costly resupply of oxygen from Earth. The best option today is a combination of three chemical-physical processes, namely a solid amine based carbon dioxide concentration system, a carbon dioxide reduction system (Sabatier reactor), and a fixed bed alkaline electrolyzer. In order to develop the Sabatier reactor technology, a breadboard unit was designed and tested. ESA

N92-25888# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
CARBON DIOXIDE REDUCTION ABOARD THE SPACE STATION **c54**
L. I. Gavrilov, V. A. Naumov, A. I. Rjabkin (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR), T. N. Pavlova, N. M. Samsonov, and N. S. Farafonov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 473-475 (For primary document see N92-25828 16-18)
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Classification of carbon dioxide reduction processes to be used in CO2 processing systems is considered. The advantages and

the problems of realization of the processes are considered. The results obtained in the development of a unit prototype based on the Sabatier process are discussed. ESA

N92-25889# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
A SYSTEM FOR OXYGEN GENERATION FROM WATER ELECTROLYSIS ABOARD THE MANNED SPACE STATION MIR **c54**
J. E. Belaventsev, L. I. Gavrilov, A. S. Guzenberg, N. S. Gushin, V. P. Korolev, A. G. Pshenichnikov, A. M. Rjabkin (Academy of Sciences, USSR, Moscow), N. M. Samsonov, and N. S. Farafonov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 477-479 (For primary document see N92-25828 16-18)
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The problems arising from the development of systems for oxygen supply aboard the manned Mir Space Station are discussed. Electrolytic process realization, gas/electrolyte separation operational safety, and product oxygen quality are considered. The results of the Earth based system development and long term operation aboard the Space Station Mir are presented. The approaches to the improvement in the system design are contemplated. ESA

N92-25890# AiResearch Mfg. Co., Torrance, CA.
DEVELOPMENT OF A SABATIER CARBON DIOXIDE REDUCTION SYSTEM FOR SPACE APPLICATION **c54**
Hal J. Strumpf and C. Y. Chin *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 481-487 (For primary document see N92-25828 16-18)
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A carbon dioxide reduction system is being developed for long duration manned space missions. The system incorporates a Sabatier methanation reactor, utilizing previously developed catalyst materials, and a hollow fiber membrane unit to separate the products of reaction. Heat produced by the exothermic Sabatier reaction is absorbed by an air stream, which also regulates the reactor temperature to maximize yield. This absorbed heat can be utilized elsewhere in the carbon dioxide management system to reduce power requirements. The Sabatier process combines carbon dioxide and hydrogen to form methane and water. In a manned space environment, the water is then either electrolyzed to form oxygen for breathing and hydrogen to drive the reaction, or recycles to the potable water system. A computer based performance model using finite elements was developed to evaluate reactor design and catalyst performance. Performance calculations for the preliminary reactor design indicate hydrogen conversion of over 99 percent in a carbon dioxide rich reaction. ESA

N92-25891# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
AIR REGENERATION FROM MICROCONTAMINANTS ABOARD THE ORBITAL SPACE STATION **c54**
N. M. Samsonov, L. K. Abramov, L. E. Litvinov, V. I. Margulis, A. S. Guzenberg, and A. M. Rjabkin (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 489-491 (For primary document see N92-25828 16-18)
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Major problems relating to the development of a system for atmospheric regeneration from harmful microcontaminants are dealt with: a classification of the composition of harmful contaminants, the formulation of the model composition of microcontaminants present in the atmosphere, the regeneration process flow diagram, the regeneration method, the accelerated lifetime test procedures. The results of Earth based complete tests of the system incorporated in the mockups of the module Kvant, the orbital Space Station Mir, a complex of the Space Station Mir/Kvant-2 as well as the development flight tests aboard an orbital complex of the Space Station Mir/Kvant/Kvant-2 are illustrated. The basic energy/mass characteristics of the system are described. ESA

N92-25892# CJB Developments Ltd., Portsmouth (England).
AIR PURIFICATION SYSTEMS FOR SUBMARINES AND THEIR RELEVANCE TO SPACECRAFT **c54**
R. A. J. Dams, C. J. Leppard, and T. W. Martin *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 493-497 (For primary document see N92-25828 16-18)
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A submarine's effectiveness is determined in part by its ability to remain summerged for extended periods. If this is to be achieved with a manned vessel, it is essential that the submarine is fitted with the means to maintain a safe and pleasant atmosphere for the crew to breathe. Nuclear powered submarines may remain isolated from the surface for 90 days or more and their atmosphere control problems are therefore complex. An air purification system must be capable of providing atmosphere constituents which are required by the human physiological process and also of removing harmful contaminants. In practice, this requires that oxygen is replenished and that carbon dioxide, carbon monoxide, hydrogen, Freons, vapors and aerosols are removed. Techniques developed for these purposes in submarines may well have application in a spacecraft. ESA

N92-25893*# Applied Sciences Consultants, Inc., San Jose, CA.
MATHEMATICAL MODELING OF CONTROL SUBSYSTEMS FOR CELSS: APPLICATION TO DIET **c54**
Ahmad Waleh, Thoi K. Nguyen, and Valery Kanevsky *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 501-505 (For primary document see N92-25828 16-18)
(Contract NAS2-13260)
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The dynamic control of a Closed Ecological Life Support System (CELSS) in a closed space habitat is of critical importance. The development of a practical method of control is also a necessary step for the selection and design of realistic subsystems and processors for a CELSS. Diet is one of the dynamic factors that strongly influences, and is influenced, by the operational states of all major CELSS subsystems. The problems of design and maintenance of a stable diet must be obtained from well characterized expert subsystems. The general description of a mathematical model that forms the basis of an expert control program for a CELSS is described. The formulation is expressed in terms of a complete set of time dependent canonical variables. System representation is dynamic and includes time dependent storage buffers. The details of the algorithm are described. The steady state results of the application of the method for representative diets made from wheat, potato, and soybean are presented. ESA

N92-25894# Empresarios Agrupados, Madrid (Spain).
ECOSIM: AN ENVIRONMENTAL CONTROL SIMULATION SOFTWARE **c54**
R. Perez, V. Torroglosa, A. Lebru, and M. Novara (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 507-513 (For primary document see N92-25828 16-18)
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The capabilities of the ECOSIM software, primarily intended to simulate Environmental Control and Life Support (ECLS), are discussed. It may be also customized to the simulation of passive and active thermal control systems, power systems, and more generally any system which can be described as a set of

interconnected physical components. ECOSIM will provide a powerful continuous simulation language, a graphical user interface and a library of ECLSS custom made components. The major aims of the development are reviewed and the basic end aspects, i.e., the simulation language and the graphical user interface, are presented though examples aiming at enhancing their understanding. ECOSIM version 1, to be released in 1992, will provide capabilities for simulating air management systems of the degree of complexity encountered in the Hermes and Columbus projects. ESA

N92-25895# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
TRACE GAS CONTAMINATION CONTROL (TGCC) ANALYSIS SOFTWARE FOR COLUMBUS **c54**
H. P. Hafkemeyer *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 515-520 (For primary document see N92-25828 16-18)
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In pressurized habitable environments, the respirable atmosphere is contaminated by gaseous trace contaminants generated by off gassing from materials and surfaces, by leakage from pressurized systems and by metabolic processes of crew members and living organisms or from experiments. These contaminants might be removed from the atmosphere by control hardware like filters, adsorbers or catalytic oxidizers in order to control the toxical hazards. For the numerical analysis and simulation of trace gas generation and removal processes within pressurized Columbus elements, the development of a Trace Gas Contamination Control (TGCC) analysis software was initiated. The conceptual design and performance is outlined, with emphasis laid upon an input scheme compatible with ESABASE. ESA

N92-25896# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
SIMTAS: THERMO- AND FLUIDDYNAMIC SIMULATION OF COMPLEX SYSTEMS **c54**
Ralf Simon and Jens Eickhoff *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 521-527 (For primary document see N92-25828 16-18)
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In the course of the development of new environmental control and fuel cell systems for the European manned space flight program the thermophysical simulation is getting increasing importance for the assistance and verification of engineer's decisions. Also in the area of the chemical and environmental technologies increasing complexity of systems requires more and more powerful tools for their simulation. To satisfy the requests for a powerful and versatile simulation, a modular thermophysical system simulation package, called SIMTAS was developed. It is designed to meet the special requirements of practical engineering and is based on state of the art software technologies. The technical capabilities of the simulation program and some examples for its application in actual aerospace programs are described. ESA

N92-25897# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
APPLICATION OF CFD TOOLS IN SPACE PROJECTS **c34**
E. Embacher and M. Huchler *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 529-535 (For primary document see N92-25828 16-18)
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In recent years the design of spacecrafts became more and more complex. So called two phase loops, are used for thermal control where high heat rates have to be transferred. Many material experiments with fluids forming homogeneous crystals were performed or planned. At least the ventilation of manned spacecrafts as well as the detection of undesirable conditions are essential problems of todays space flight programs. To understand the physical context, to design spacecraft components or experiments and to adapt them to the special microgravity environment, it is inevitable to perform fluid dynamic analyses. Selected Computation Fluid Dynamics (CFD) applications performed on various projects are presented. ESA

N92-25898# Computer Anwendung fuer Management G.m.b.H., Heidelberg (Germany, F.R.).
PRECISE CONVECTIVE COOLING SIMULATION OF ELECTRONIC EQUIPMENT UNDER VARIOUS g-CONDITIONS
Johannes Adam, Dieter Stuempel, and Michael Rath (Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 537-540 (For primary document see N92-25828 16-18)
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Using the thermohydraulic code 'THEBES' a three dimensional flow analysis of a Spacelab rack under forced convection and a combined convective, conductive and radiative analysis of a closed electronic box under various g conditions are presented. The capabilities and features of THEBES are described. The motivation to extend the thermal analysis cycle for better treatment of fluid flow and solid to air heat transfer is discussed. It is proposed to include THEBES in a thermal analysis toolsat and present a concept for integration of THEBES with ESABASE. ESA

N92-25899*# Boeing Aerospace Co., Huntsville, AL. Missile and Space Div.
G189A MODELLING OF SPACE STATION FREEDOM'S ECLSS **c54**
Robert S. Barker and Roger vonJouanne *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 541-550 (For primary document see N92-25828 16-18)
(Contract NAS8-50000)
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The following are reviewed: the requirements and design of the Environmental Control and Life Support System (ECLSS) for Space Station Freedom; a review of the G189A ECLSS computer program model developed for the complete configuration of pressurized elements or volume; and some significant computed results from this model showing transient performance for subsystems responsible for temperature and humidity control, atmosphere control and supply, air revitalization, and water recovery and management. The computed results presented are important in assessing the capabilities of the ECLSS equipment in maintaining acceptable levels of temperature, humidity, O2, N2, and CO2 in the occupied volumes during crew changeout events. These events involve up to four extra crew members from the orbiter being located temporarily in the Space Station modules in addition to the normal contingent of four crew members. These additional crew members impose additional demands on the ECLSS equipment, in order to control the levels of the aforementioned quantities. Satisfactory control of all these quantities was achieved. The maximum computed pp CO2 was in the acceptable degraded performance regime. This level is higher than the 3.00 mm Hg upper limit for normal conditions. ESA

N92-25900# Paul Scherrer Inst., Villigen (Switzerland).
COMPOUND RADIATOR
Knud Thomsen *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 553-556 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Standard radiator design with a plate facing cold space on one side and the warm spacecraft at the other side suffers from considerable parasitic heat load to the radiator even when the back of the radiator is covered with the best Multi Layer Insulation (MLI) available. In addition, performance of the plate radiator depends crucially on its insulation which might well deteriorate

over a long duration mission. In an attempt to address these manifest and potential problems the concept of a compound radiator was worked out. First tests confirm model calculations; the compound radiator marks a very significant improvement over a standard plate radiator. ESA

N92-25901# Indian Space Research Organization, Bangalore. Thermal Systems Div.

POST-TEST CORRECTION OF THE THERMAL MATHEMATICAL MODEL OF A PASSIVE RADIANT COOLER

C. K. KrishnaPrakas, D. R. Bhandari, and H. NarayanaMurthy *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 557-560 (For primary document see N92-25828 16-18)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A passive radiant cooler was developed for the use of maintaining the infrared detector of the Very High Resolution Radiometer (VHRR) aboard Insat-2 spacecraft at cryogenic temperatures. A mathematical model of the cooler was developed. Thermal balance tests, simulating the conditions of deep space vacuum and temperature and various orbit heat loads, were conducted to verify the model. The experience gained from the tests evolved ideas to improve the cooler performance which when implemented in practice really produced results. Test data were utilized in correcting the model. The corrected model predicts the cold stage temperatures within 1 K of the observed test temperatures. ESA

N92-25902# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

SIMULTANEOUS MEASUREMENT OF SOLAR ABSORPTANCE AND TOTAL HEMISPHERICAL EMITTANCE ON A SCIENTIFIC SATELLITE AKEBONO

A. Ohnishi, Y. Nakamura, Y. Kawada, and T. Hayashi (Chiba Inst. of Tech., Narashino, Japan) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 561-564 (For primary document see N92-25828 16-18)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Results of an onboard simultaneous measurement of solar absorptance (alpha S) and total hemispherical emittance (epsilon H) for several thermal control materials are reported. This measurement was carried out with the scientific satellite Akebono. The principle of this measurement is based on a calorimetric method utilizing solar radiation and electrical heat input through a heater attached to the sample. This technique allows simultaneous determination of alpha S and epsilon H by giving several different levels of input power to the sample heater, and for the data reduction, there is no need to use the values of parameters, such as the mass or the specific heat of the sample materials. Five kinds of test samples are located on the top plat of the spacecraft to face the Sun. The result obtained for alpha S and epsilon H by the present method in the early phase is compared to the preflight data. The degradations of alpha S and epsilon H in the orbit are evaluated as a function of equivalent Sun hours. ESA

N92-25903# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

FORMATION OF A VERY LOW-REFLECTANCE SURFACE BY ELECTROSTATIC FLOCKING **c33**

A. Kato, A. Onishi, and T. Hayashi *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 565-568 (For primary document see N92-25828 16-18)

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The implantation of carbon pile perpendicular to the substrate, thereby making it possible to form a surface having a very low reflectance owing to the so called light trap effect, where light beams incident of the surface are reflected and attenuated among the fibers no matter at which angle the light beam may incident, are considered. How very low reflectance flocked surfaces were achieved over a wide range of wavelengths from near ultraviolet to the infrared range by optimizing the cut length, heat treatment, and quantity of the carbon pile for lift is described. ESA

N92-25904# Pilkington P.E. Ltd., Bodelwyddan (Wales).

DEVELOPMENT OF ENHANCED OPTICAL SOLAR REFLECTORS FOR IMPROVED THERMAL CONTROL

K. Mullaney *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 569-571 (For primary document see N92-25828 16-18)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The thermooptical properties of Optical Solar Reflectors (OSRs) can be modified by thin films. Development activity has produced a solar absorptance of 0.04. The ultraviolet reflector was combined with a conductive layer for electrostatic discharge resistance, and can now function over a range of solar flow incidence angles. An update on work carried out is provided. ESA

N92-25905# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

HIGH CAPACITY GROOVED HEAT PIPES **c34**

M. Dubois, S. VanOost, G. Bekaert, and W. Supper (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 575-581 (For primary document see N92-25828 16-18)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The development of a High capacity Grooved heat Pipe (HGP), based on the thermal requirements of the next generation of telecommunication satellites, is considered. Promising concepts and methods of groove technology were reviewed. A tradeoff and design study performed on potential HGP concepts, taking into account theoretical performances (in 1 g and in 0 g), ease of manufacturing and of assembly as well as the head pipe working reliability and priming capability. The two selected concepts are aluminum extruded heat pipes (25 mm outer diameter), based on a multireentrant grooves concept or on a mixed open/reentrant grooves concept. The acceptance test program to which both HGP heat pipes were submitted, includes leak proof and bursts as well as classical thermal tests. The test results show the fulfilment of the required specifications in heat transport capacity as on tilt capability: the experimental maximum heat transport capability was found to be near 1500 Wm (horizontally at 20C) for a required 600 Wm while the maximum tilt capability was measured between 15 and 20 mm (at 20C). ESA

N92-25906# All-Union Research Inst. of Electromechanics, Moscow (USSR).

LIFE TESTS OF ALUMINIUM AXIAL GROOVE HEAT PIPES WITH ACETONE AS A WORKING FLUID **c34**

A. D. Lobanov, A. A. Yatsenko, M. D. Parfentiev, and L. V. Barkova *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 583-586 (For primary document see N92-25828 16-18)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Functional acceleration and storage life test results of 70 low temperature aluminum Heat Pipes (HP) with acetone are presented. To provide long term tests at elevated temperature, thermostats on gas controlled HPs were developed ensuring that the required temperature was kept during the tests. Based on studies and test data and using the Arrhenius equation, the time was determined for which the HP can operate at specified temperature levels. ESA

N92-25907# Joint Research Centre of the European Communities, Petten (Netherlands).

ASSESSMENT OF AN IMPROVED MODEL FOR THE HEAT TRANSFER COEFFICIENT OF GROOVED HEAT PIPE EVAPORATORS **c34**

P. C. Stephan and C. A. Busse *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 587-592 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Predictions from an improved model of the radial heat transfer coefficient of grooved heat pipe evaporators are compared with experimental data from an Al/NH3 heat pipe. Good agreement is found. The observed temperature dependence of the heat transfer coefficient is explained. ESA

N92-25908# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
NEW THERMAL COMPONENTS TO CONTROL HIGH DENSITY HEAT TRANSFER
J. Held and J. Hauser *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 593-598 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Thermal control design takes into consideration simplicity, flexibility, feasibility and the possibility to test. An uncomplicated design uses as far as possible passive thermal elements, e.g., coatings, insulations and different kinds of conductive materials and devices. Satellites and space stations of today and of the near future are very complicated. Power consumption and waste heat dissipation increases permanently compared to mainly constant spacecraft volume. Only active thermal control strategies can meet the stringent limits of the temperature requirements. Components of the present active thermal control are mainly heaters. In a few cases shutters and louvers are used. Other possibilities are Peltier elements, variable conductance heat pipes and cooling loops. All these components have severe disadvantages, e.g., high electrical power consumption, difficult regulation characteristics and/or short lifetime. Liquid Trap Heat Pipes (LTHP), and a MultiFunctional Thermal Interface (MUFTI) offer the possibility to simplify the thermal control strategies. The amount of electrical power can be reduced drastically. The proper function of the thermal diode, which is similar to a LTHP, is verified on a flight experiment. The feasibility and characteristics of MUFTI is shown by ground tests. ESA

N92-25909# British Aerospace Public Ltd. Co., Stevenage (England).
A CONTROL RESERVOIR FOR TWO-PHASE HEAT TRANSPORT SYSTEMS
N. Dunbar *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 599-606 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

An active accumulator/control reservoir was identified as a critical component of two phase heat transport systems, serving to regulate the evaporating pressure (and thus loop operating temperature) by control of the flooding level within two phase condensing units. Provision of a full control range able to accommodate wide variations in heat load and desired set point requires a large working volume, but with the ability to make very small adjustments on command from a control algorithm. The accumulator/control reservoir designed and built for the European mechanically pumped two phase heat transport system, and operating within a system test bed is described. ESA

N92-25910# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Life Support Div.
IN-ORBIT DEMONSTRATION OF TWO-PHASE TECHNOLOGY c34
W. Supper, A. A. M. Delil, and M. Dubois (Societe Anonyme Beige de Constructions Aeronautiques, Brussels.) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 607-612 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

For large scale, future space applications (Space Station, possibly Columbus and Polar Platform) thermal management systems employing two phase heat transfer loops are currently being considered. However, as two phase flow and transfer differ in their behavior when subjected to a 1 g or a low gravity environment, the technology of two phase heat transport systems and their components has to be demonstrated in orbit. Therefore the development of a Two Phase loop Experiment (TPX) was started. The design of TPX is discussed together with an overview of the data acquisition and control unit and the planned operational scenario. ESA

N92-25983*# Massachusetts Inst. of Tech., Cambridge. Space Engineering Research Center.
SEMIANNUAL REPORT, JANUARY 1992
Apr. 1992 356 p
(Grant NAGw-1335)
(NASA-CR-190242; NAS 1.26:190242; SERC-4-92-R) Avail: NTIS HC/MF A16

The objective of the Space Engineering Research Center is to develop and disseminate a unified technology of controlled structures, to codify and disseminate this technology, and to train a generation of skilled engineers. The disciplinary research with the Controlled Structures Testbed (CST) is ongoing. The interferometer testbed became operational and is an active vehicle for researchers. The engineering model of the Mid-Deck Active Control Experiment (MACE) multibody test article also was commissioned. It is a pathfinder for control of articulated flexible structures. The Mid-Deck 0-Gravity Dynamics Experiment (MODE) experiment flew on STS-48. Its goals were to examine the dynamics of space structures in zero-gravity. Author

N92-26041# Naval Postgraduate School, Monterey, CA.
THE ATTITUDE CONTROL OF FLEXIBLE SPACECRAFT M.S. Thesis
R. J. Watkins, Jr. Jun. 1991 84 p
(AD-A245882) Avail: NTIS HC/MF A05

The design of the Naval Postgraduate School's Flexible Spacecraft Simulator and the first attempts at simulation and control of the model are detailed. The effect of flexible structures on the attitude control spacecraft has been a topic of research for many years. Only recently has the technology to actually test models and theory on the ground been available. At the Naval Postgraduate School, an experimental testbed for research into this area has been contracted. This facility has a model of a satellite with a flexible arm floating on air pads to eliminate the effects of friction. A mathematical model of the system has been constructed and simulations of various maneuvers have been run, utilizing proportional-derivative (PD) control as well as a Linear-Quadratic-Gaussian (LQG) compensator. Results show that both PD and LQG work well for station keeping, but that the LQG compensator is better for slewing the arm. GRA

N92-26043*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTONOMOUS RENDEZVOUS AND DOCKING CONFERENCE, VOLUME 1
1990 94 p Conference held in Houston, TX, 15-16 Aug. 1990
(NASA-TM-105082; JSC-24626; NAS 1.15:105082) Avail: NTIS HC/MF A05

This document consists of the presentation submitted at the Autonomous Rendezvous and Docking (ARD) Conference. It contains three volumes: ARD hardware technology; ARD software technology; and ARD operations. The purpose of this conference is to identify the technologies required for an on orbit demonstration of the ARD, assess the maturity of these technologies, and provide the necessary insight for a quality assessment of the programmatic management, technical, schedule, and cost risks. H.A.

N92-26153# Naval Postgraduate School, Monterey, CA.
ACTIVE DAMPING OF VIBRATIONS ON SPACE STATION FREEDOM USING LINEAR, QUADRATIC GAUSSIAN CONTROL, AND H(INFINITY) CONTROL M.S. Thesis
Jacqueline R. McClusky Dec. 1991 100 p
(AD-A245741) Avail: NTIS HC/MF A05

Active damping of modal oscillation is critical to the success of future versions of Space Station Freedom. Vibratory motion may be induced by versions of Space Station Freedom. Vibratory motion may be induced by external disturbances such as solar and gravity gradient torques, extra vehicular and experimental activity, aerodynamic forces, the earth's magnetic field, and space shuttle docking. Linear proof mass actuators can provide control on the space station to achieve this damping effect. Two control algorithm, Linear Quadratic Gaussian control and H infinity control are applied to a model of Space Station Freedom. The results compare the robustness, stability and performance of the Space Station under the effects of each of the two control algorithms.
GRA

N92-25373# National Space Development Agency, Tokyo (Japan). Space Station Group.
SPACE STATION PROGRAM AND PRELIMINARY DESIGN OF JEM
Kuniaki Shiraki *In its* Preprints of NASDA's 6th Technical Symposium 5 Jun. 1991 p 23-52 In JAPANESE; ENGLISH summary (For primary document see N92-25371 16-16)
Avail: NTIS HC/MF A06

N92-25374# National Space Development Agency, Ibaraki (Japan).
DESIGN OF ORBITAL RE-ENTRY EXPERIMENT VEHICLE AND OUTLINE OF THE EXPERIMENT
Toshio Akimoto, Tomoyuki Kobayashi, Motoyuki Inaba, Tatsushi Izumi, and Isao Kawano *In its* Preprints of NASDA's 6th Technical Symposium 5 Jun. 1991 p 53-93 In JAPANESE; ENGLISH summary (For primary document see N92-25371 16-16)
Avail: NTIS HC/MF A06

N92-25621# National Space Development Agency, Tokyo (Japan). Earth Observation Satellite Group.
DEVELOPMENT STATUS OF SPACE CRAFT
Chu Ishida *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 1-6 (For primary document see N92-25620 16-43)
(EW-1) Avail: NTIS HC/MF A08

N92-25769# Oulu Univ. (Finland). Fysiikan Laitos ja Konetekniikan Osasto.
WORK EXPERIENCES ON THE DESIGN OF THE CLUSTER SATELLITE [KOKEMUKSIA CLUSTER-SATELLIITEN DESIGN-TYOESTAE]
Kauko Lappalainen *In its* Second Meeting of Finnish Space Researchers 1990 p 23-24 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N92-25147*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FEASIBILITY STUDY OF A LOW-ENERGY GAMMA RAY SYSTEM FOR MEASURING QUANTITY AND FLOW RATE OF SLUSH HYDROGEN
Jag J. Singh, Chih-Ping Shen, and Danny R. Sprinkle (Old Dominion Univ., Norfolk, VA.) Apr. 1992 14 p
(NASA-TP-3150; L-16980; NAS 1.60:3150) Avail: NTIS HC/MF A03

As part of a study to demonstrate the suitability of an X-ray or gamma ray probe for monitoring the quality and flow rate of slush hydrogen, mass attenuation coefficients for Cd-109 X- and gamma radiation in five chemical compounds were measured. The Ag-109 K rays were used for water and acetic acid, whereas E3 transition from the first excited state at 87.7 keV in Ag-109 provided the probe radiation for bromobenzene, alpha (exp 2) chloroisodurene, and cetyl bromide. Measurements were made for a single phase (gas, liquid, solid) as well as mixed phases (liquid plus solid) in all cases. It was shown that the mass attenuation coefficient for the selected radiations is independent of the phase of the test fluids or phase ratios in the case of mixed phase fluids. Described here are the procedure and the results for the five fluid systems investigated.
Author

N92-25194*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONCEPTUAL DESIGN AND STRUCTURAL ANALYSIS OF THE SPECTROSCOPY OF THE ATMOSPHERE USING FAR INFRARED EMISSION (SAFIRE) INSTRUMENT
Robert W. Moses and Robert D. Averill Apr. 1992 50 p
(NASA-TM-104144; NAS 1.15:104144) Avail: NTIS HC/MF A03

The conceptual design and structural analysis for the Spectroscopy of the Atmosphere using Far Infrared Emission (SAFIRE) Instrument are provided. SAFIRE, which is an international effort, is proposed for the Earth Observing Systems (EOS) program for atmospheric ozone studies. A concept was developed which meets mission requirements and is the product of numerous parametric studies and design/analysis iterations. Stiffness, thermal stability, and weight constraints led to a graphite/epoxy composite design for the optical bench and supporting struts. The structural configuration was determined by considering various mounting arrangements of the optical, cryo, and electronic components. Quasi-static, thermal, modal, and dynamic response analyses were performed, and the results are presented for the selected configuration.
Author

N92-25385*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
A TECHNIQUE FOR MEASURING VERTICALLY AND HORIZONTALLY POLARIZED MICROWAVE BRIGHTNESS TEMPERATURES USING ELECTRONIC POLARIZATION-BASIS ROTATION Final Report, 1 Jun. 1990 - 30 Nov. 1991
Albin J. Gasiewski 13 Apr. 1992 27 p
(Grant NAG8-829)
(NASA-CR-190207; NAS 1.26:190207) Avail: NTIS HC/MF A03

This technique for electronically rotating the polarization basis of an orthogonal-linear polarization radiometer is based on the measurement of the first three feedhorn Stokes parameters, along with the subsequent transformation of this measured Stokes vector into a rotated coordinate frame. The technique requires an accurate measurement of the cross-correlation between the two orthogonal feedhorn modes, for which an innovative polarized calibration load was developed. The experimental portion of this investigation consisted of a proof of concept demonstration of the technique of electronic polarization basis rotation (EPBR) using a ground based 90-GHz dual orthogonal-linear polarization radiometer. Practical calibration algorithms for ground-, aircraft-, and space-based instruments were identified and tested. The theoretical effort consisted of radiative transfer modeling using the planar-stratified numerical model described in Gasiewski and Staelin (1990).
Author

N92-25759# Outokumpu Oy Electronics, Espoo (Finland).
SPECTRUM-X-GAMMA: GAS FILLED POSITION SENSITIVE COUNTERS
Tor Andersson, Panu Jalas, M. Maaspuro, Seppo Nenonen, and H. Sipilae *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 1-2 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25775# Technical Research Centre of Finland, Espoo. Instrumenttitekniikan Lab.
CONSTRUCTION AND EXPLOITATION OF NEW REMOTE SENSING INSTRUMENTS [UUSIEN KAUKOKARTOITUSINSTRUMENTTIEN RAKENTAMINEN JA KAEYTTOE]
Kai Maekisara *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 35-36 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25781# Hollming Oy Elektroniikka, Tampere (Finland).
PARTICIPATION OF FINNISH COMPANIES IN SPACE STUDIES [TEOLLISUUSYRITYKSEN OSALLISTUMINEN AVARUUSTUTKIMUKSEEN]
Heikki Rautonen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 51-52 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25792# Helsinki Univ. of Technology, Espoo (Finland). Observatory and Astrophysics Lab.
SOLID STATE SPECTROMETER ARRAY ON BOARD SPECTRUM-X-GAMMA
Osmi Vilhu *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 75-76 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-25200*# Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engines and Space Propulsion.
THRUST CHAMBER MATERIAL TECHNOLOGY PROGRAM Final Report, Aug. 1983 - Aug. 1986
J. S. Andrus and R. G. Bordeau Mar. 1989 198 p
(Contract NAS3-23858)
(NASA-CR-187207; NAS 1.26:187207; FR-20672) Avail: NTIS HC/MF A09

This report covers work performed at Pratt & Whitney on development of copper-based materials for long-life, reusable, regeneratively cooled rocket engine thrust chambers. The program approached the goal of enhanced cyclic life through the application of rapid solidification to alloy development, to introduce fine dispersions to strengthen and stabilize the alloys at elevated temperatures. After screening of alloy systems, copper-based alloys containing Cr, Co, Hf, Ag, Ti, and Zr were processed by rapid-solidification atomization in bulk quantities. Those bulk alloys showing the most promise were characterized by tensile testing, thermal conductivity testing, and elevated-temperature, low-cycle fatigue (LFC) testing. Characterization indicated that Cu- 1.1 percent Hf exhibited the greatest potential as an improved-life thrust chamber material, exhibiting LCF life about four times that of NASA-Z. Other alloys (Cu- 0.6 percent Zr, and Cu- 0.6 percent Zr- 1.0 percent Cr) exhibited promise for use in this application, but needed more development work to balance properties.
Author

N92-25249*# Advanced Solar Power Engineering Consultants, Austin, TX.
A PRELIMINARY DESIGN FOR A SATELLITE POWER SYSTEM
Clara V. Enriquez, Ray Kokaly, Saumya Nandi, Mike Timmons, Mark Garrard, Rommel Mercado, Brian Rogers, and Victor Ugaz 9 May 1991 97 p Prepared for Texas Univ., Austin
(Contract NASw-4435)
(NASA-CR-190012; NAS 1.26:190012) Avail: NTIS HC/MF A05

Outlined here is a preliminary design for a Solar Power Satellite (SPS) system. The SPS will provide a clean, reliable source of energy for mass consumption. The system will use satellites in geostationary orbits around the Earth to capture the sun's energy. The intercepted sunlight will be converted to laser beam energy which can be transmitted to the Earth's surface. Ground systems on the Earth will convert the transmissions from space into electric power. The preliminary design for the SPS consists of one satellite in orbit around the Earth transmitting to one ground station. The SPs technology uses multi-layer solar cell technology arranged on a 20 sq km planar array to intercept sunlight and convert it to an electric voltage. Power conditioning devices then send the electricity to a laser, which transmits the power to the surface of the Earth. A ground station will convert the beam into electricity. Construction will take place in low Earth orbit and array sections, 20 in total, will be sailed on the solar wind out to the GEO location in 150 days. These individual transportation sections are referred to as solar sailing panels (SSAPs). The primary truss elements used to support the arrays are composed on composite tubular members in a pentahedral arrangement. Smart segments consisting of passive and active damping devices will increase the control of dynamic SPS modes.
Author

N92-25343*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA PROGRAMS IN SPACE PHOTOVOLTAICS
Dennis J. Flood 1992 14 p Presented at the 6th International Photovoltaic Science and Engineering Conference, New Delhi, India, 10-14 Feb. 1992; sponsored by Dept. of Non-Conventional Energy Sources, Government of India, Solar Energy Society of India and National Physical Lab
(NASA-TM-105428; E-6844; NAS 1.15:105428) Avail: NTIS HC/MF A03

Highlighted here are some of the current programs in advanced space solar cell and array development conducted by NASA in support of its future mission requirements. Recent developments are presented for a variety of solar cell types, including both single crystal and thin film cells. A brief description of an advanced concentrator array capable of AM0 efficiencies approaching 25 percent is also provided.
Author

N92-25605*# TRW, Inc., Redondo Beach, CA. Space and Technology Group.
SPACE STORABLE ROCKET TECHNOLOGY (SSRT) BASIC PROGRAM Final Report
M. L. Chazen, T. Mueller, A. R. Casillas, and D. Huang 12 May 1992 100 p
(Contract NAS3-26246)
(NASA-CR-189131; NAS 1.26:189131; TRW-SN-56372-000)
Avail: NTIS HC/MF A05

The Space Storable Rocket Technology Program (SSRT) was conducted to establish a technology for a new class of high performance and long life bipropellant engines using space storable propellants. The results are described. Task 1 evaluated several characteristics for a number of fuels to determine the best space storable fuel for use with LO2. The results indicated that LO2-N2H4 is the best propellant combination and provides the maximum mission/system capability maximum payload into GEO of satellites. Task 2 developed two models, performance and thermal. The performance model indicated the performance goal of specific impulse greater than or = 340 seconds (sigma = 204) could be achieved. The thermal model was developed and anchored to hot fire test data. Task 3 consisted of design, fabrication, and testing of a 200 lbf thrust test engine operating at a chamber pressure of 200 psia using LO2-N2H4. A total of 76 hot fire tests were conducted demonstrating performance greater than 340 (sigma = 204) which is a 25 second specific impulse improvement over the existing highest performance flight apogee type engines.
Author

N92-25616*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMAL STRATIFICATION POTENTIAL IN ROCKET ENGINE COOLANT CHANNELS
Kenneth J. Kacynski May 1992 14 p
(NASA-TM-4378; E-6135; NAS 1.15:4378) Avail: NTIS HC/MF A03

The potential for rocket engine coolant channel flow stratification was computationally studied. A conjugate, 3-D, conduction/advection analysis code (SINDA/FLUINT) was used. Core fluid temperatures were predicted to vary by over 360 K across the coolant channel, at the throat section, indicating that the conventional assumption of a fully mixed fluid may be extremely inaccurate. Because of the thermal stratification of the fluid, the walls exposed to the rocket engine exhaust gases will be hotter than an assumption of full mixing would imply. In this analysis, wall temperatures were 160 K hotter in the turbulent mixing case than in the full mixing case. The discrepancy between the full mixing and turbulent mixing analyses increased with increasing heat transfer. Both analysis methods predicted identical channel resistances at the coolant inlet, but in the stratified analysis the thermal resistance was negligible. The implications are significant. Neglect of thermal stratification could lead to underpredictions in nozzle wall temperatures. Even worse, testing at subscale conditions may be inadequate for modeling conditions that would exist in a full scale engine. Author

N92-26085*# Mechanical Technology, Inc., Latham, NY.
NUMERICAL, ANALYTICAL, EXPERIMENTAL STUDY OF FLUID DYNAMIC FORCES IN SEALS Final Interim Report No. 1
William Shapiro, Antonio Artiles, Bharat Aggarwal, Jed Walowit, Mahesh M. Athavale, and Andrzej J. Preskwas (Computational Fluid Dynamics Research Corp., Huntsville, AL.) Apr. 1992 313 p
(Contracts NAS3-25644; NAS8-37824; NAS8-38101)
(NASA-CR-189113; NAS 1.26:189113) Avail: NTIS HC/MF A14

NASA/Lewis Research Center is sponsoring a program for providing computer codes for analyzing and designing turbomachinery seals for future aerospace and engine systems. The program is made up of three principal components: (1) the development of advanced three dimensional (3-D) computational fluid dynamics codes, (2) the production of simpler two dimensional (2-D) industrial codes, and (3) the development of a knowledge based system (KBS) that contains an expert system to assist in seal selection and design. The first task has been to concentrate on cylindrical geometries with straight, tapered, and stepped bores. Improvements have been made by adoption of a colocated grid formulation, incorporation of higher order, time accurate schemes for transient analysis and high order discretization schemes for spatial derivatives. This report describes the mathematical formulations and presents a variety of 2-D results, including labyrinth and brush seal flows. Extensions of 3-D are presently in progress. Author

N92-26089*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
ORBIT TRANSFER ROCKET ENGINE TECHNOLOGY PROGRAM: AUTOMATED PREFLIGHT METHODS CONCEPT DEFINITION Final Report
C. M. Erickson and D. W. Hertzberg Dec. 1991 116 p
(Contract NAS3-23773)
(NASA-CR-187190; NAS 1.26:187190; AD-A244465; RI/RD-91-145) Avail: NTIS HC/MF A06

The possibility of automating preflight engine checkouts on orbit transfer engines is discussed. The minimum requirements in terms of information and processing necessary to assess the engine'e integrity and readiness to perform its mission were first defined. A variety of ways for remotely obtaining that information were generated. The sophistication of these approaches varied from a simple preliminary power up, where the engine is fired up for the first time, to the most advanced approach where the sensor and operational history data system alone indicates engine integrity. The critical issues and benefits of these methods were identified, outlined, and prioritized. The technology readiness of each of these automated preflight methods were then rated on a NASA Office of Exploration scale used for comparing technology options for future mission choices. Finally, estimates were made of the remaining cost to advance the technology for each method to a level where the system validation models have been demonstrated in a simulated environment. Author

N92-26122# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SHUTTLE ROCKET MOTOR PROGRAM: NASA SHOULD DELAY AWARDING SOME CONSTRUCTION CONTRACTS. REPORT TO THE CHAIR, SUBCOMMITTEE ON GOVERNMENT ACTIVITIES AND TRANSPORTATION, COMMITTEE ON GOVERNMENT OPERATIONS, HOUSE OF REPRESENTATIVES
Apr. 1992 8 p
(GAO/NSIAD-92-201; B-248285) Avail: NTIS HC/MF A02; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first copy free, additional copies $2.00

Even though the executive branch has proposed terminating the Advanced Solid Rocket Motor (ASRM) program, NASA is proceeding with all construction activity planned for FY 1992 to avoid schedule slippage if the program is reinstated by Congress. However, NASA could delay some construction activities for at least a few months without affecting the current launch data schedule. For example, NASA could delay Yellow Creek's motor storage and dock projects, Stennis' dock project, and Kennedy's rotation processing and surge facility and dock projects. Starting all construction activities as originally planned could result in unnecessarily incurring additional costs and termination liability if the funding for FY 1993 is not provided. If Congress decides to continue the program, construction could still be completed in time to avoid schedule slippage. Author

N92-25932*# Rockwell International Corp., Huntsville, AL.
PROBABILISTIC DESIGN APPLICATIONS FOR THE SPACE TRANSPORTATION MAIN ENGINES
Kevin OHara *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 447-471 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

23 CHEMISTRY AND MATERIALS (GENERAL)

N92-25203*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GRAPHITE INTERCALATION COMPOUND WITH IODINE AS THE MAJOR INTERCALANT
Ching-Cheh Hung and Donald Kucera (Cleveland State Univ., OH.) 1992 20 p Presented at the 20th Biennial Conference on Carbon, Santa Barbara, CA, 23-28 Jun. 1991; sponsored by the American Carbon Society
(NASA-TM-105375; E-6762; NAS 1.15:105375) Avail: NTIS HC/MF A03

Halogenated CBr(sub x)I(sub y) (1 less than y/x less than 10) was made by exposing graphite materials with interplanar spacing in the 3.35 to 3.41 A range to either pure Br2 or an I2-Br2 mixture, and then to iodine vapor containing a small amount of Br2. The electrical resistivity of this product is from 3 to 6.5 times the pristine value. The presence of a small amount of isoprene rubber in the reaction significantly increased the iodine to bromine ratio in the product. In this reaction, rubber is known to generate HBr and to slowly remove bromine from the vapor. The halogenation generally caused a 22 to 25 percent weight increase. The halogens were found uniformly distributed in the product interior. However, although the surface contains very little iodine, it has high concentrations of bromine and oxygen. It is believed that the high

concentrations of bromine and oxygen in this surface cause the halogenated fiber to be more resistant to fluorine attack during subsequent fluorination to fabricate graphite fluoride fibers.
Author

N92-26142*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TRIBOLOGICAL AND MICROSTRUCTURAL COMPARISON OF HIPPED PM212 AND PM212/Au SELF-LUBRICATING COMPOSITES
Michael S. Bogdanski, Harold E. Sliney, and Christopher DellaCorte Apr. 1992 19 p Prepared for presentation at the STLE-ASME Joint Tribology Conference, San Diego, CA, 18-21 Oct. 1992
(Contract DE-AI01-91CR-50306)
(NASA-TM-105615; E-6952; NAS 1.15:105615; DOE/NASA/50306-1) Avail: NTIS HC/MF A03

The feasibility of replacing the silver with the volumetric equivalent of gold in the chromium carbide-based self-lubricating composite PM212 (70 wt. percent NiCo-Cr3C2, 15 percent BaF2/CaF2 eutectic) was studied. The new composite, PM212/Au has the following composition: 62 wt. percent NiCo-Cr3C2, 25 percent Au, 13 percent BaF2/CaF2 eutectic. The silver was replaced with gold to minimize the potential reactivity of the composite with possible environmental contaminants such as sulfur. The composites were fabricated by hot isostatic pressing (HIPping) and machined into pin specimens. The pins were slid against nickel-based superalloy disks. Sliding velocities ranged from 0.27 to 10.0 m/s and temperatures from 25 to 900 C. Friction coefficients ranged from 0.25 to 0.40 and wear factors for the pin and disk were typically low 10(exp -5) cu mm/N-m. HIPped PM212 measured fully dense, whereas PM212/Au had 15 percent residual porosity. Examination of the microstructures with optical and scanning electron microscopy revealed the presence of pores in PM212/Au that were not present in PM212. Though the exact reason for the residual porosity in PM212/Au was not determined, it may be due to particle morphology differences between the gold and silver and their effect on powder metallurgy processing. Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials*.

N92-25160*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BUCKLING BEHAVIOR OF LONG SYMMETRICALLY LAMINATED PLATES SUBJECTED TO COMBINED LOADINGS
Michael P. Nemeth May 1992 31 p Presented at the Ninth DoD/FAA Conference on Fibrous Composites in Structural Design, Lake Tahoe, NV, 4-7 Nov. 1991
(NASA-TP-3195; L-17035; NAS 1.60:3195) Avail: NTIS HC/MF A03

A parametric study is presented of the buckling behavior of infinitely long, symmetrically laminated anisotropic plates subjected to combined loadings. The loading conditions considered are axial tension and compression transverse tension and compression, and shear. Results obtained using a special-purpose analysis, well-suited for parametric studies, are presented for clamped and simply supported plates. Moreover, results are presented for some common laminate constructions, and generic buckling design charts are presented for a wide range of parameters. The generic design charts are presented in terms of useful nondimensional parameters, and the dependence of the nondimensional parameters on laminate fiber orientation, stacking sequence, and material properties is discussed. An important finding of the study is that the effects of anisotropy are much more pronounced in shear-loaded plates than in compression-loaded plates. In addition, the effects of anisotropy on plates subjected to combined loadings are generally manifested as a phase shift of self-similar buckling interaction curves. A practical application of this phase shift is that the buckling resistance of long plates can be improved by applying a shear loading with a specific orientation. In all cases considered in the study, the buckling coefficients of infinitely long plates are found to be independent of the bending stiffness ratio (D sub 11/D sub 22)(1/4). Author

N92-25199# Lawrence Livermore National Lab., CA.
QUANTITATIVE FILM RADIOGRAPHY
J. M. Hernandez, C. M. Logan, P. B. Mohr, and D. L. Weirup 11 Feb. 1992 18 p
(Contract W-7405-eng-48)
(DE92-008986; UCRL-ID-106201-Rev-1) Avail: NTIS HC/MF A03

We have developed a system of quantitative radiography in order to produce quantitative images displaying homogeneity of parts. The materials that we characterize are synthetic composites and may contain important subtle density variations not discernable by examining a raw film x radiograph. In order to quantitatively interpret film radiographs, it is necessary to digitize, interpret, and display the images. Our integrated system of quantitative radiography displays accurate, high resolution pseudo-color images in units of density. We characterize approximately 10,000 parts per year in hundreds of different configurations and compositions with this system. DOE

N92-25224# Texas Univ., Austin. Dept. of Chemistry.
VECTORIAL ELECTRON TRANSFER IN SPATIALLY ORDERED ARRAYS
M. A. Fox Jan. 1992 6 p
(Contract DE-FG05-85ER-13387)
(DE92-008753; DOE/ER-13387/72) Avail: NTIS HC/MF A02

Progress was made in several areas: the synthesis of new materials for directional electron; the preparation and characterization of anisotropic composites bearing organic and inorganic components; and the elaboration of mechanisms of electrocatalysis. Additionally, the development of new methods for surface modification of metals and semiconductors is discussed. DOE

N92-25251# Atomic Energy Research Inst., Daeduk (Republic of Korea).
THE DEVELOPMENT OF SiC WHISKER FABRICATION TECHNOLOGY FOR NUCLEAR APPLICATIONS
Thae Khapp Kang, Il Hiun Kuk, Chang Kyu Kim, Jae Chun Lee, Ho Jin Lee, Soon Dong Park, and Gyeong Soo Im Feb. 1991 139 p In KOREAN; ENGLISH summary
(DE92-614834; KAERI/RR-977/90) Avail: NTIS HC/MF A07

Some important experiments for whisker growth reactions, fabrication processes, and experiments for fabrication of whisker reinforced composites were performed. In order to investigate growth reaction of SiC whiskers, a conventional carbothermic reaction was tested. Based on the results of the carbothermic process, a new process called silicothermic reaction was planned and some basic experiments were performed. Reaction characteristics of silicon monoxide, core material for SiC whisker growth in both of the reactions, were investigated for basic data. Additionally, a hydrofluoric acid leaching process was tested for developing SiC whisker recovery process, and a powder metallurgy process and a melt squeeze process were tried to develop aluminum-SiC whisker composites. DOE

N92-25345*# Aerospace Corp., El Segundo, CA. Engineering and Technology Group.
CHARACTERIZATION OF LOW THERMAL CONDUCTIVITY PAN-BASED CARBON FIBERS
Howard A. Katzman, P. M. Adams, T. D. Le, and Carl S. Hemminger 15 Mar. 1992 125 p Sponsored by NASA. Marshall Space Flight Center
(Contract F04701-88-C-0089)
(NASA-CR-190312; NAS 1.26:190312; ATR-91(6819)-1) Avail: NTIS HC/MF A06

The microstructure and surface chemistry of eight low thermal conductivity (LTC) PAN-based carbon fibers were determined and

compared with PAN-based fibers heat treated to higher temperatures. Based on wide-angle x ray diffraction, the LTC PAN fibers all appear to have a similar turbostratic structure with large 002 d-spacings, small crystallite sizes, and moderate preferred orientation. Limited small-angle x ray scattering (SAXS) results indicate that, with the exception of LTC fibers made by BASF, the LTC fibers do not have well developed pores. Transmission electron microscopy shows that the texture of the two LTC PAN-based fibers studied (Amoco T350/23X and /25X) consists of multiple sets of parallel, wavy, bent layers that interweave with each other forming a complex three dimensional network oriented randomly around the fiber axis. X ray photoelectron spectroscopy (XPS) analysis finds correlations between heat treated temperatures and the surface composition chemistry of the carbon fiber samples.
Author

N92-25346*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPOSITES OF LOW-DENSITY TRIALUMINIDES: PARTICULATE AND LONG FIBER REINFORCEMENTS
K. S. Kumar, M. S. DiPietro, S. A. Brown (Martin Marietta Labs., Baltimore, MD.), and J. D. Whittenberger Apr. 1992 99 p
(Contract NAS3-26069)
(NASA-TM-105628; E-6970; NAS 1.15:105628) Avail: NTIS HC/MF A05

An examination of the ternary L1(sub 2) trialuminides, Al66Ti25Mn9, Al67Ti25Cr8, and Al22Ti8Fe3 in compression, bending, and tension revealed that none of these compounds exhibited a desirable balance of strength, ductility, and oxidation resistance. Subsequently, specific quaternary and quinary compositions were cast, homogenized, and isothermally forged. Both, the monolithic material and its particulate reinforced counterparts were examined in compression, three point bend, and tension as a function of temperature, and at high temperatures as a function of strain rate. An alternate approach that was examined in this program to enhance the low temperature damage tolerance of these materials was to incorporate long refractory metal wires in the matrix. In summary, it appears that of the various matrix compositions examined, ternary Al66Ti25Mn9 exhibits the best balance in strength, ductility, and oxidation resistance. Although the idea of refractory metal wire reinforcement is an attractive one, a successful combination remains to be identified.
Author

N92-25367*# Washington Univ., Saint Louis, MO. Lab. for Ultrasonics.
ULTRASONIC NONDESTRUCTIVE CHARACTERIZATION OF COMPOSITES WITH 3-DIMENSIONAL ARCHITECTURES
Semiannual Progress Report, 15 Sep. 1991 - 14 Mar. 1992
James G. Miller 14 Mar. 1992 29 p
(Grant NsG-1601)
(NASA-CR-190244; NAS 1.26:190244) Avail: NTIS HC/MF A03

The development and implementation of advanced composite material systems and their associated technologies are critical for success in the highly competitive world aerospace market. Acceptance of advance production methods and field support of structures made with these new materials require the development of quantitative, cost-effective, inspection methods. The results of quantitative ultrasonic through-transmission imaging of composites with complex three-dimensional architecture using phase-insensitive and phase-sensitive techniques are presented.
D.R.D.

N92-25567 Michigan Univ., Ann Arbor.
A MODEL FOR THE CRUSH OF POLYMER MATRIX COMPOSITE TUBES Ph.D. Thesis
Joseph A. Hulway 1991 103 p
Avail: Univ. Microfilms Order No. DA9208561

Understanding the crush behavior of structures manufactured from polymer matrix composites is important to the automotive industry because of the potential use of these materials in areas of the vehicle where crash energy management must be considered. Because of the many variables involved in the fabrication of composites, it is desirable to develop a modelling technique to allow the prediction of crush performance based on a limited number of material properties. The role of mode I interlaminar fracture in the crush of composites was studied to determine if a model could be developed to predict its contribution to the crushing process. Laminated strips, with a midplane delamination at the end, were compressed against a crush plate to propagate the delamination crack down the length of the strip. Energy models were developed to account for strain, friction, and mode I fracture energies. These models were then evaluated to predict the force required to propagate the crack as a function of crack length. The force and crack length at which the process reached a steady state condition were also predicted. The model was modified to account for mode II interlaminar fracture and in-plane fracture that occur in composite tubes undergoing stable crush. Crush force as a function of crack depth was predicted for round tubes.
Dissert. Abstr.

N92-25575 Wisconsin Univ., Milwaukee.
THE DAMPING PROPERTIES OF COMPOSITE MATERIALS Ph.D. Thesis
Warren Alan Lederman 1991 148 p
Avail: Univ. Microfilms Order No. DA9126321

The damping properties of metal matrix composites is of interest in structural applications, such as space structures, where it is felt that the material damping could contribute significantly to minimizing unwanted vibrations. The investigation focuses on the experimental and analytical aspects of damping mechanisms in particulate metal matrix composites. It used an instrumented hammer, an accelerometer, and a Zonic 6088 fast Fourier transform frequency analyzer to determine the damping ratios of a variety of test samples being subjected to free vibration. The damping ratios were obtained by using the half power bandwidth technique. Analysis was developed to compare a theoretical prediction of the damping ratio with the experimental data.
Dissert. Abstr.

N92-25579 State Univ. of New York, Buffalo.
FABRICATION AND MECHANICAL BEHAVIOUR OF ALUMINUM MATRIX COMPOSITE MATERIALS Ph.D. Thesis
Taewon Lim 1991 164 p
Avail: Univ. Microfilms Order No. DA9121046

Aluminum matrix composite materials containing SiC whisker and Saffil alumina short fiber are fabricated by the squeeze casting method. It is demonstrated that the direct squeeze casting infiltration method is suitable for discontinuously reinforced metal matrix composites (MMC's) whose volume fractions are in the range of 0.15-0.3; squeeze casting of compounds for the fabrication of discontinuous MMC's with less volume fractions (less than 0.1). Mechanical properties, such as Young's modulus and ultimate tensile strength, are improved up to 80 percent by the addition of reinforcement. Hardness is improved by the incorporation of reinforcement. Optimum aging conditions for MMC's are determined. The peak aging time decreases with increasing the aging temperature and decreasing the volume fraction of reinforcement. Predictions for the elastic moduli and tensile strength are proposed from the transformed laminate analogy, and combinations of modified rule of mixtures and shear lag theory. Wear resistance of the composite is improved. The major wear mechanism of discontinuous MMC's is strongly dependent upon the sliding speed. Weight loss increases linearly with the sliding distance. From fracture surface analyses at room and elevated temperatures, it is found that the failure mode is ductile at the microstructural level and it becomes more ductile as temperature increases. Based on the fracture surface observations and experimental data, the strength reduction at elevated temperatures is due to overaging and softening of the matrix alloy. Failure mechanisms of the as-fabricated composites are summarized.
Dissert. Abstr.

N92-25754*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FREE VIBRATIONS OF DELAMINATED BEAMS
M.-H. H. Shen (Ohio State Univ., Columbus.) and J. E. Grady

Apr. 1992 27 p
(NASA-TM-105582; E-6909; NAS 1.15:105582) Avail: NTIS HC/MF A03

Free vibration of laminated composite beams is studied. The effect of interply delaminations on natural frequencies and mode shapes is evaluated both analytically and experimentally. A generalized vibrational principle is used to formulate the equation of motion and associated boundary conditions for the free vibration of a composite beam with a delamination of arbitrary size and location. The effect of coupling between longitudinal vibration and bending vibration is considered. This coupling effect is shown to significantly affect the calculated natural frequencies and mode shapes of the delaminated beam. Author

N92-25963*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A MICROMECHANICS-BASED STRENGTH PREDICTION METHODOLOGY FOR NOTCHED METAL MATRIX COMPOSITES
C. A. Bigelow Apr. 1992 19 p Presented at the Fatigue and Fracture of Inorganic Composites, Cambridge, England, 31 Mar. - 2 Apr. 1992
(NASA-TM-107616; NAS 1.15:107616) Avail: NTIS HC/MF A03

An analytical micromechanics based strength prediction methodology was developed to predict failure of notched metal matrix composites. The stress-strain behavior and notched strength of two metal matrix composites, boron/aluminum (B/Al) and silicon-carbide/titanium (SCS-6/Ti-15-3), were predicted. The prediction methodology combines analytical techniques ranging from a three dimensional finite element analysis of a notched specimen to a micromechanical model of a single fiber. In the B/Al laminates, a fiber failure criteria based on the axial and shear stress in the fiber accurately predicted laminate failure for a variety of layups and notch-length to specimen-width ratios with both circular holes and sharp notches when matrix plasticity was included in the analysis. For the SCS-6/Ti-15-3 laminates, a fiber failure based on the axial stress in the fiber correlated well with experimental results for static and post fatigue residual strengths when fiber matrix debonding and matrix cracking were included in the analysis. The micromechanics based strength prediction methodology offers a direct approach to strength prediction by modeling behavior and damage on a constituent level, thus, explicitly including matrix nonlinearity, fiber matrix debonding, and matrix cracking. Author

N92-25996*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
X RAY ATTENUATION MEASUREMENTS FOR HIGH-TEMPERATURE MATERIALS CHARACTERIZATION AND IN-SITU MONITORING OF DAMAGE ACCUMULATION Ph.D. Thesis - Cleveland State Univ., 1991
George Y. Baaklini Mar. 1992 221 p Original contains color illustrations
(NASA-TM-105577; E-6652; NAS 1.15:105577) Avail: NTIS HC/MF A10; 44 functional color pages

The scope of this dissertation is to develop and apply x ray attenuation measurement systems that are capable of: (1) characterizing density variations in high-temperature materials, e.g., monolithic ceramics, ceramic and intermetallic matrix composites, and (2) noninvasively monitoring damage accumulation and failure sequences in ceramic matrix composites under room temperature tensile testing. This dissertation results in the development of: (1) a point scan digital radiography system, and (2) an in-situ x ray material testing system. Radiographic evaluation before, during, and after loading shows the effect of preexisting volume flaws on the fracture behavior of composites. Results show that x ray film radiography can monitor damage accumulation during tensile loading. Matrix cracking, fiber matrix debonding, fiber bridging, and fiber pullout are imaged throughout the tensile loading of the specimens. Further in-situ radiography is found to be a practical technique for estimating interfacial shear strength between the silicon carbide fibers and the reaction bonded silicon nitride matrix. It is concluded that pretest, in-situ, and post test x ray imaging can provide for greater understanding of ceramic matrix composite mechanical behavior. Author

N92-26102*# College of William and Mary, Williamsburg, VA.
RAPID DETECTION AND QUANTIFICATION OF IMPACT DAMAGE IN COMPOSITE STRUCTURES
Barry T. Smith 31 Jan. 1992 26 p
(Grant NAG1-1063)
(NASA-CR-190367; NAS 1.26:190367) Avail: NTIS HC/MF A03

It is shown that a multidisciplinary nondestructive evaluation approach for impact damage detection in composite structures can be used to produce a more efficient inspection. The multidisciplinary NDE approach relies on fast large area thermographic inspections along with detailed ultrasonic volumetric imaging. The thermal inspection technique rapidly identifies the impact damage. The ultrasonic volumetric imaging quantifies the impact generated delaminations through the volume of the structure. Author

N92-26148*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DETERMINATION OF STRESS INTENSITY FACTORS FOR INTERFACE CRACKS UNDER MIXED-MODE LOADING
Rajiv A. Naik (Analytical Services and Materials, Inc., Hampton, VA.) and John H. Crews, Jr. May 1992 31 p Proposed for presentation at the ASTM National Symposium on Fracture Mechanics, Gatlinburg, TN, 30 Jun. - 2 Jul. 1992
(NASA-TM-107624; NAS 1.15:107624) Avail: NTIS HC/MF A03

A simple technique was developed using conventional finite element analysis to determine stress intensity factors, K1 and K2, for interface cracks under mixed-mode loading. This technique involves the calculation of crack tip stresses using non-singular finite elements. These stresses are then combined and used in a linear regression procedure to calculate K1 and K2. The technique was demonstrated by calculating three different bimaterial combinations. For the normal loading case, the K's were within 2.6 percent of an exact solution. The normalized K's under shear loading were shown to be related to the normalized K's under normal loading. Based on these relations, a simple equation was derived for calculating K1 and K2 for mixed-mode loading from knowledge of the K's under normal loading. The equation was verified by computing the K's for a mixed-mode case with equal and normal shear loading. The correlation between exact and finite element solutions is within 3.7 percent. This study provides a simple procedure to compute K2/K1 ratio which has been used to characterize the stress state at the crack tip for various combinations of materials and loadings. Tests conducted over a range of K2/K1 ratios could be used to fully characterize interface fracture toughness. Author

N92-25923*# California Univ., Santa Barbara.
MODELING BRITTLE HIGH-TEMPERATURE COMPOSITE STRUCTURES
K. T. Kedward, R. M. McMeeking, and S. Janson *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 253-268
(For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-25150# Sandia National Labs., Albuquerque, NM.
THE EFFECT OF SOLVENT AND PARTICLE DIELECTRIC CONSTANTS ON THE ELECTRORHEOLOGICAL PROPERTIES OF WATER-FREE ER FLUIDS

T. Garino, D. Adolf, and B. Hance 1991 8 p Presented at the Electrorheological Fluids Conference, Carbondale, IL, 15-16 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-008674; SAND-91-1683C; CONF-9110290-2) Avail: NTIS HC/MF A02

The properties of water-free electrorheological (ER) fluids containing electrically insulating ceramic particles were studied. Results on fluids containing particles with different dielectric constants, (epsilon sub p), in dodecane (epsilon sub s = 2) indicate that strong ER effects can occur due to dielectric constant mismatch. For example, in a fluid containing 40 vol percent BaTiO3, the yield stress was greater than 1.2 times 10(exp 4) dyn/cm(exp 2) at 700 V/mm. The yield stress of these fluids depends on epsilon (exp p) much more strongly than predicted by the point dipole approximation, especially at high particle contents. The yield stress was also independent of frequency between 10 and 4000 Hz. However, when the fluid contained 2-methylcyclohexanol (epsilon sub s) = 13, a much higher conductivity solvent, the yield stress increases strongly with frequency. This occurs because the dielectric mismatch mechanism only operates above a critical frequency that depends on the electrical conductivity of the liquid. DOE

N92-25155# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
COMPREHENSIVE MECHANISMS FOR COMBUSTION CHEMISTRY: AN EXPERIMENTAL AND NUMERICAL STUDY WITH EMPHASIS ON APPLIED SENSITIVITY ANALYSIS
Frederick L. Dryer and Richard A. Yetter Feb. 1992 16 p
(Contract DE-FG02-86ER-13503)
(DE92-008852; DOE/ER-13503/5) Avail: NTIS HC/MF A03

This research program is an integrated effort to determine the reaction mechanisms responsible for the oxidation of small molecule hydrocarbon structures under conditions representative of combustion environments. The experimental aspects of the work are conducted in an atmospheric pressure flow reactor (APFR) as well as in a new variable pressure flow reactor (VPFR) facility which extends the ranges of parameters available in the APFR, particularly the pressure, (1-15 atm.), the temperature (600 K to 1200 K), and the observation time (10 to 5000 milli-seconds). Gas sampling of stable reactant, intermediate, and product species concentrations provide substantial definition of not only the phenomenology of reaction mechanisms, but a much more constrained set of pure kinetic information than can be derived in flames, or shock tubes. Analytical techniques used for detecting hydrocarbons and carbon oxides include gas chromatography, gas chromatography/mass spectrometry for off-time analyses. Non-dispersive infrared and Fourier transform infrared methods are utilized for continuous on-line sample detection of light hydrocarbons, carbon oxides, and oxygenated species. The modeling aspects of the program emphasize the use of hierarchical mechanistic construction along with path and elemental gradient sensitivity analyses in developing detailed kinetic mechanisms. Modeling using a well defined and validated mechanism for the CO/H2/Oxidant systems and perturbations of experimental oxidations by small amounts of additives are also used to derive absolute reaction rates and to investigate the compatibility of elementary kinetic rate information. DOE

N92-25165*# International Business Machines Corp., San Jose, CA. Research Div.
THE DETERMINATION OF ACCURATE DIPOLE POLARIZABILITIES ALPHA AND GAMMA FOR THE NOBLE GASES
Julia E. Rice, Peter R. Taylor, Timothy J. Lee, and Jan Almloef (Minnesota Univ., Minneapolis.) 1989 25 p Previously announced in IAA as A91-33449
(Contract NCC2-371; NSF CHE-89-15629)
(NASA-CR-190252; NAS 1.26:190252) Avail: NTIS HC/MF A03

The static dipole polarizabilities alpha and gamma for the noble gases helium through xenon were determined using large flexible one-particle basis sets in conjunction with high-level treatments of electron correlation. The electron correlation methods include single and double excitation coupled-cluster theory (CCSD), an extension of CCSD that includes a perturbational estimate of connected triple excitations, CCSD(T), and second order perturbation theory (MP2). The computed alpha and gamma values are estimated to be accurate to within a few percent. Agreement with experimental data for the static hyperpolarizability gamma is good for neon and xenon, but for argon and krypton the differences are larger than the combined theoretical and experimental uncertainties. Based on our calculations, we suggest that the experimental value of gamma for argon is too low; adjusting this value would bring the experimental value of gamma for krypton into better agreement with our computed result. The MP2 values for the polarizabilities of neon, argon, krypton and zenon are in reasonabe agreement with the CCSD and CCSD(T) values, suggesting that this less expensive method may be useful in studies of polarizabilities for larger systems. Author

N92-25208# Lawrence Livermore National Lab., CA.
FIDELITY FLUCTUATION IN SBS PHASE CONJUGATION AT HIGH INPUT ENERGIES
C. B. Dane, L. A. Hackel, and W. A. Neuman (Idaho National Engineering Lab., Idaho Falls.) 27 Jan. 1992 9 p Presented at the Society of Photo-Optical Instrumentation Engineers' International Symposium on Laser Spectroscopy, Los Angeles, CA, 19-24 Jan. 1992
(Contract W-7405-eng-48)
(DE92-008923; UCRL-JC-107785; CONF-920124-15) Avail: NTIS HC/MF A02

The shot-to-shot phase fidelity of a stimulated Brillouin scattering (SBS) phase conjugator operated many times above threshold has been found to be very sensitive to the slope of the leading edge of the input pulse. For a pulse with a rising edge that is short relative to the acoustic lifetime of the SBS medium, strong random fluctuations in the fidelity of the wavefront reversal are observed. However, by tailoring the leading edge of the pulse relative to the acoustic response time of the medium, good phase reproduction can be achieved. No increase in shot-to-shot fidelity fluctuation was observed using a carbon tetrachloride SBS cell at input energies up to 100X threshold, resulting in reflectivities of 90 pct. Conclusions are made about the source of the observed random fluctuations which are supported both by experimental measurements and numerical modeling. DOE

N92-25221# Grambling State Univ., LA.
NQR-NMR STUDIES OF HIGHER ALCOHOL SYNTHESIS Cu-Co CATALYSTS
17 Dec. 1991 10 p
(Contract DE-FG22-89PC-89762)
(DE92-008694; DOE/PC-89762/T12) Avail: NTIS HC/MF A02

Previous studies of the zerofield NMR spectra of Cu/Co catalysts revealed that the method of preparation sensitively influences the magnetic character of the catalyst. Catalytic studies of the earlier investigators also show similar influence on the product selectivity and indicate reproducible performance is critically dependent on the control and rigor of the preparation technique. To complement the NMR results, we have made a thorough investigation of the hysteresis character of the Cu/Co catalysts with the metal ratio varying from 0.2 to 4.0. DOE

N92-25286# Technische Univ., Delft (Netherlands). Section Reservoir Engineering.
NITROGEN FLOODING VERSUS METHANE FLOODING IN VOLATILE OIL RESERVOIRS Ph.D. Thesis
Diederik Michiel Boersma Nov. 1990 148 p Sponsored in part by Commission of the European Communities
(ISBN-90-9003876-0; ETN-92-91308) Avail: NTIS HC/MF A07

Research to find out whether nitrogen is a good alternative to natural gas for injection into deep, high pressure reservoirs of volatile oil (for example in the North Sea) to improve oil recovery, is described. The following are addressed: description of the phase behavior and physical properties of volatile oil/injection gas systems; determination of the Minimum Miscibility Pressure (MMP)

of volatile oil for methane and nitrogen flooding; flooding experiments in a slim tube apparatus; numerical simulation of slim tube experiments. Main conclusions are: dispersion has a negative effect on multiple contact miscibility; because of dispersion, the recovery efficiency of displacements above the MMP can differ depending on the compositions of the reservoir fluid and of the injection gas and on the operating pressure; the evaporation capacity of the injection gas is an important sreening criterion; although nitrogen flooding in a volatile oil reservoir will yield high recoveries, the recovery will be better for methane flooding because of the more favorable displacement characteristics. ESA

N92-25336# Akron Univ., OH. Dept. of Chemical Engineering.
THE EFFECT OF CHEMICAL ADDITIVES ON THE SYNTHESIS OF ETHANOL
S. S. C. Chuang 20 Dec. 1991 10 p
(Contract DE-FG22-87PC-79923)
(DE92-007808; DOE/PC-79923/T10) Avail: NTIS HC/MF A02

The objective of this research is to elucidate the role of various chemical additives on ethanol synthesis over Rh- and Ni-based catalysts. Chemical additives used for this study include S, P, Ag, Cu, Mn, and Na which have different electronegativities. The effects of additives on the surface state of the catalysts, heat of adsorption of reactant molecules, reaction intermediates, reaction pathways, reaction kinetics, and product distributions is/will be investigated by a series of experimental studies of NO adsorption, reaction probing, study state rate measurement, and transient kinetic study. A better understanding of the role of additives on the synthesis reaction may allow us to use chemical additives to manipulate the catalytic properties of Rh- and Ni-based catalysts for producing high yields of ethanol from syngas. DOE

N92-25341# International Centre for Theoretical Physics, Trieste (Italy).
CORRELATIONS BETWEEN ENTROPY AND VOLUME OF MELTING IN HALIDE SALTS
Z. Akdeniz (Istanbul Univ., Turkey) and M. P. Tosi Sep. 1991 21 p
(DE92-617435; IC-91/311) Avail: NTIS HC/MF A03

Melting parameters and transport coefficients in the melt are collated for halides of monovalent, divalent, and trivalent metals. A number of systems show a deficit of entropy of melting relative to the linear relationships between entropy change and relative volume change on melting. These are found to be approximately obeyed by a majority of halides. These behaviors are discussed on the basis of structural and transport data. The deviating systems are classified into three main classes, namely: (1) fast-ion conductors in the high-temperature crystal phase such as AgI, (2) strongly structured network-like systems such as ZnCl2, and (3) molecular systems melting into associated molecular liquids such as SbCl3. DOE

N92-25399*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
METAL ETCHING COMPOSITION Patent
Joseph E. OTousa, inventor (to NASA), Clark S. Thomas, inventor (to NASA), and Robert E. Foster, inventor (to NASA) 23 Jul. 1991 3 p Filed 25 Sep. 1990
(NASA-Case-MFS-29576-1; US-Patent-5,034,093;
US-Patent-Appl-SN-587890; US-Patent-Class-156-664;
US-Patent-Class-156-656; US-Patent-Class-252-79.2;
US-Patent-Class-252-79.4; Int-Patent-Class-B44C-1/22;
Int-Patent-Class-C23F-1/00; Int-Patent-Class-C09K-13/00) Avail: US Patent and Trademark Office

The present invention is directed to a chemical etching composition for etching metals or metallic alloys. The composition includes a solution of hydrochloric acid, phosphoric acid, ethylene glycol, and an oxidizing agent. The etching composition is particularly useful for etching metal surfaces in preparation for subsequent fluorescent penetrant inspection.
Official Gazette of the U.S. Patent and Trademark Office

N92-25407# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
STUDIES ON RELATIVE EFFECTS OF CHARGED AND NEUTRAL DEFECTS IN HYDROGENATED AMORPHOUS SILICON
M. Silver (North Carolina Univ., Chapel Hill.) Feb. 1992 12 p
(Contract DE-AC02-83CH-10093)
(DE92-001212; NREL/TP-451-4691) Avail: NTIS HC/MF A03

This report covers the third year of a continuing research study to understand the relative importance of charged and neutral defects in amorphous silicon. The objective of the study is to explore the electronic structure, including neutral and charged defects, an optoelectronic effects including the formation of Staebler-Wronski defects. The study concentrated on exploring electroluminescence experimentally and interpreting the results employing a simple guiding model. The simple guiding model assumes an exponential density of states and recombination rate constants (radiative and non-radiative) which are governed by hopping transitions. Measurements were also made as a function of photodegradation of the material. The results implicate that the radiative recombination processes are not distant pair tunneling but rather results from electrons hopping down due to the coulomb interactions. Preliminary experiments were made on the effect of photodegradation on transient space charge limited currents in n/i/n structures. These experiments can directly yield information on the occupied defects centers induced by the photodegradation and are not a result of recombination processes. To date the results seems to be consistent with a picture which places the doubly occupied defects at quite a high energy (approximately equal to 0.4 e.v. below the conduction band). DOE

N92-25421# City Coll. of the City Univ. of New York, NY.
HYDROGEN RECOVERY BY NOVEL SOLVENT SYSTEMS
R. Shinnar, Z. Ludmer, and A. Ullmann Aug. 1991 97 p
(Contract DE-AC21-87MC-23292)
(DE92-001103; DOE/MC-23292/3030) Avail: NTIS HC/MF A05

The objective of this work is to develop a novel method for purification of hydrogen from coal-derived synthesis gas. The study involved a search for suitable mixtures of solvents for their ability to separate hydrogen from the coal derived gas stream in significant concentration near their critical point of miscibility. The properties of solvent pairs identified were investigated in more detail to provide data necessary for economic evaluation and process development. DOE

N92-25483# Northwestern Univ., Evanston, IL.
CHEMICAL INTERACTIONS IN MULTIMETAL/ZEOLITE CATALYSTS
W. M. H. Sachtler Feb. 1992 21 p
(Contract DE-FG02-87ER-13654)
(DE92-008214; DOE/ER-13654/2) Avail: NTIS HC/MF A03

Mechanistic explanations have been found for the migration of atoms and ions through the zeolite channels leading to specific distribution of ions and the metal clusters. In this report, we summarize the state of understanding attained on a number of topics in the area of mono- and multimetal/zeolite systems, to which our recent research has made significant contributions. The following topics are discussed: (1) formation of isolated metal atoms in sodalite cages; (2) differences of metal/zeolite systems prepared by ion reduction in channels or via isolated atoms; (3) rejuvenation of Pd/NaY and Pd/HY catalysts by oxidative redispersion of the metal; (4) formation of mono- or bimetal particles in zeolites by programmed reductive decomposition of volatile metal complexes; (5) cation-cation interaction as a cause of enhanced reducibility; (6) formation of palladium carbonyl clusters in supercages; (7) enhanced catalytic activity of metal particle-proton complexes for hydrocarbon conversion reactions; and (8) stereoselectivity of catalytic reactions due to geometric constraints of particles in cages. DOE

N92-25484# Los Alamos National Lab., NM.
REPORT ON STUDY OF OXIDATION REACTION RATES
P. M. Dhooge (Delphi Research, Inc., Albuquerque, NM.) 10

Jun. 1991 23 p
(Contract W-7405-eng-36)
(DE92-008247; LA-SUB-92-1) Avail: NTIS HC/MF A03

A series of experiments were conducted to determine the rate of oxidation of scintillation cocktail components, vacuum pump oil and trichloroethylene by Delphi Research, Inc.'s patented MEDETOX catalytic wet oxidation process utilizing iron(3) oxidant. The materials were placed in acid digestion bombs with the catalytic solution and heated to temperatures in the range of 150 to 225 C in the presence of platinum(4), ruthenium(3), or palladium(2) homogeneous cocatalysts. The amount of iron(2) generated in the oxidation of the organics was determined by titration with cerium(4) using 1,10-phenanthroline indicator. Post oxidation gas chromatography analysis was performed using a purge-trap system and volatiles column. Results showed reaction rate constants in the range of 10(exp -7) to 10(exp -4) sec(exp -1), depending on the cocatalyst, acidity, type of anions, type of organic, temperature and ratio of iron(3) to iron(2). Chloride ion was found to significantly reduce the reaction rate constant for many of the organics. Acid concentration had no significant effect on the rate constant at acid concentrations lower than about 1.0 molar, but significantly lower rate constants were obtained at acid concentrations much greater than 2.0 molar; lower acid concentrations resulted in unacceptable precipitation of iron oxides. Over-all oxidation activation energies ranged from 6.0 kcal/mole for trichloroethylene to 7.6 kcal/mole for toluene. The results indicate that complete oxidation of these hazardous organics, and presumably many others, can be achieved at 200 to 250 C if the ratio of iron(3) to iron(2) in the catalyst solution is kept at a value of 5 or greater. DOE

N92-25747# Northwestern Univ., Evanston, IL.
CHEMICAL INTERACTIONS IN MULTIMETAL/ZEOLITE CATALYSTS
W. M. H. Sachtler Feb. 1992 5 p
(Contract DE-FG02-87ER-13654)
(DE92-008103; DOE/ER-13654/1) Avail: NTIS HC/MF A01

For Pt/NaY catalysts our analysis of the mechanism of metal particle formation has enabled us to produce at will samples which contain either the majority of the Pt particles in supercages, without filling these cages completely, or the Pt particles bulge into neighboring cages. The catalytic selectivity is distinctly different for these preparations, in the former case molecules can enter a supercage which is partially filled by the Pt cluster, in the second case adsorption takes place through the cage window. Applying the same principles of catalyst preparation of bimetallic catalysts enables us to produce PtCu particles in supercages of NaY, which contain, initially a Pt core, surrounded by a Cu mantle. Earlier we have found that Ni ions migrate into hexagonal prisms during calcination of Ni/NaY; this process can be partially suppressed by first filling these prisms with Mn or Cr ions. In more recent work we found that addition of Pt strongly lowers the temperature of Ni reduction. Part of the Ni ions is reduced by hydrogen while still inside the smaller cages. This reduction process is, however, reversible; at elevated temperature and in an inert atmosphere protons re-oxidize the Ni atoms and dihydrogen gas is developed. In this way it seems possible to count the Ni atoms in small cages. The calcination stage in the preparation of zeolite supported metals has been studied in considerable detail for Pd/NaY. The Pd is introduced as a tetrammin complex; during calcination the ammine ligands are successively oxidized. Once three ammine ligands are destroyed, the Pd ions which carry only one ligand, surprisingly jump from the supercages to the sodalite cage. DOE

N92-25798# Japan Atomic Energy Research Inst., Tokyo.
DEVELOPMENT OF A LASER INDUCED PHOTOACOUSTIC SPECTROSCOPY SYSTEM FOR ANALYTICAL TECHNIQUE OF Np ION IN THE PUREX PROCESS
Takehiro Kihara, Sachio Fujine, Mitsuru Maeda, Tetsuya Matsui, Tetsuo Fukasawa, Masaharu Sakagami, Takashi Ikeda, and Takehiko Kitamori (Tokyo Univ., Japan) Sep. 1991 61 p In JAPANESE; ENGLISH summary
(DE92-768092; JAERI-M-91-142) Avail: NTIS HC/MF A04

A new system of laser induced photoacoustic spectroscopy (LIPAS) has been developed for Np ions. The LIPAS system is composed of a YAG laser driven dye laser, a flow type cell with piezoelectric transducer (PZT), and digital storage oscilloscope. In the case of neodymium analysis, which was used as a simulant for Np ion, the detection limit absorptivity was 3.1 x 10(exp -5)/cm and the detection limit concentration was 4.4 x 10(exp -6) M. These values show that the sensitivity of the present LIPAS system is two orders higher than that of spectrophotometry. The system has been applied to analyze Np(V) in nitric acid. In order to protect PZT from corrosion, the surface of PZT was coated with poly-vinyl chloride. The detection limit absorptivity was 3.6 x 10(exp -5)/cm and the detection limit concentration was 1.8 x 10(exp -6) M for the system. These values are two orders lower than that of spectrophotometry. The photoacoustic (PA) signal of Np(V) ions is amplified by coexisting uranium ions. Magnitude of the amplification was reported to be inversely proportional to the specific heat of solution. It was found that the signal intensity of Np(V) in the Np-U solution agrees well with the multification product of specific heat of uranium and the PA signal of Np(V) for Np solution without uranium. The detection limit concentration of Np(V) for Np-U solution was 2.5 x 10(exp -6) M. This value indicates that the LIPAS system is able to determine Np(V) ions. The feasibility of the LIPAS system is studied. DOE

N92-25804# Arkansas Univ., Fayetteville. Dept. of Chemistry.
TIME-RESOLVED ELECTRON DIFFRACTION STUDIES Report, 1 Oct. 1990 - 30 Sep. 1991
Lothar Schafer 10 Sep. 1991 11 p Sponsored by ONR
(AD-A245780) Avail: NTIS HC/MF A03

It is the goal of this research to perform gas electron diffraction (GED) studies, time-resolved and non-time resolved, of the photochemical and thermal decomposition of RDX and trinitro-azetidine. The two compounds are highly explosive; therefore, the GED experiments are not routine and feasibility of the project had to be demonstrated first by recording the ground state data of the two systems. Two specific problems were identified and discussed in the original proposal: (1) whether or not effective vapor densities of RDX or TNAZ can be achieved which are sufficient for GED studies; and (2) whether or not important intermediates of decomposition can be identified in the product mixtures after flash heating or laser excitation. GRA

N92-26012# Northwestern Univ., Evanston, IL. Dept. of Chemistry.
SUPPORTED ORGANOMETALLIC COMPLEXES: SURFACE CHEMISTRY, SPECTROSCOPY, AND CATALYSIS
T. J. Marks Feb. 1992 14 p
(Contract DE-FG02-86ER-13511)
(DE92-010017; DOE/ER-13511/5) Avail: NTIS HC/MF A03

The long-range goal of this project is to elucidate and understand the surface chemistry and catalytic properties of well-defined, highly-reactive organometallic molecules (principally based upon abundant actinide, lanthanide, and early transition elements) adsorbed on metal oxides and halides. The nature of the adsorbed species is probed by a battery of chemical and physicochemical techniques to understand the nature of the molecular-surface coordination chemistry and how this can give rise to extremely high catalytic activity. A complementary objective is to delineate the scope and mechanisms of the heterogeneous catalytic reactions, as well as to relate them both conceptually and functionally to model systems generated in solution. DOE

N92-26035# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
USE OF HIGH LATERAL RESOLUTION SECONDARY ION MASS SPECTROMETRY TO CHARACTERIZE SELF-ASSEMBLED MONOLAYERS ON MICROFABRICATED STRUCTURES Technical Report No. 45, 1990-1991
C. D. Frisbie, J. R. Martin, R. R. Duff, Jr., and M. S. Wrighton 4 Feb. 1992 21 p
(Contract N00014-84-K-0553)
(AD-A245797) Avail: NTIS HC/MF A03

Our work on the surface coordination chemistry of microfabricated structures has inspired us to develop methodologies for detecting the presence of a monolayer of surface-confined molecules at high lateral resolution. Previous work from this laboratory has shown that it is possible to selectively derivatize microlithographically patterned gold and platinum surfaces with self-assembled monolayers (SAM's) of redox active molecules, R-L, as shown in Scheme 1, where L is -SH or -NC, known to coordinate to Au and Pt. Verification of the selective binding of intact molecules in our studies to date has been provided by a combination of electrochemical and surface sensitive spectroscopic techniques, including cyclic voltammetry, x-ray photoelectron spectroscopy (XPS), and scanning Auger electron spectroscopy (AES). GRA

N92-26036# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
CHEMICALLY SENSITIVE MICROELECTROCHEMICAL DEVICES: NEW APPROACHES TO SENSORS Technical Report No. 46, 1990-1991
C. A. Mirkin, J. R. Valentine, D. Ofer, J. J. Hickman, and M. S. Wrighton 4 Feb. 1992 30 p
(Contract N00014-84-K-0553)
(AD-A245798) Avail: NTIS HC/MF A03

Described herein are the proof of concept results demonstrating a new approach to electrochemical sensors based upon chemically sensitive microelectrochemical devices. A typical device consists of at least two individually addressable electrodes. The working electrode is a microelectrode and is derivatized with at least one molecule that has a chemically sensitive formal potential and serves as the indicator, and one molecule that has a chemically insensitive formal potential and serves as a reference. The indicator and reference molecules are confined to the electrodes either by monolayer self assembly techniques or by dissolving in a thin film of solid electrolyte. Detection in these systems is accomplished by measuring either the potential difference associated with current peaks for oxidation (or reduction) of microelectrode confined redox reagents. GRA

N92-25816*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STUDY OF SHOCK-INDUCED COMBUSTION USING AN IMPLICIT TVD SCHEME
Shayne Yungster *In its* Computational Fluid Dynamics Feb. 1992 p 93-101 Original contains color illustrations (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-25169# Sandia National Labs., Albuquerque, NM.
RAPID ANODIC DISSOLUTION BASED SCC OF AN Al-LiCu ALLOY BY ISOLATED PIT SOLUTIONS
R. G. Buchheit, Jr., J. P. Moran, F. D. Wall, and G. E. Stoner (Virginia Univ., Charlottesville.) 1991 18 p Presented at the Parkins Symposium on Fundamentals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-009064; SAND-91-1517C; CONF-9110311-2) Avail: NTIS HC/MF A03

Pre-exposure induced stress corrosion cracking (SCC) of an Al-Li-Cu, AA 2090, was studied using a variety of test techniques. Results from SCC testing in a simulated isolated pit solution are correlated with electrochemical corrosion rate data obtained for individual phases in the subgrain boundary region. These experimental data, combined with existing data on the crevice chemistry of isolated pits in Al-Li alloys and X ray diffraction studies of solid corrosion products formed in crevice environments are used to propose a model for pre-exposure induced cracking based on anodic dissolution along subgrain boundaries. Key features of the model are selective dissolution of the subgrain boundary T sub 1 phase (Al2CuLi) at the crack tip and passivation of crack walls by the formation of an Li2(Al2(OH)6)2-CO3-nH2O barrier film. DOE

N92-25206# Lawrence Livermore National Lab., CA.
ON ELIMINATING DEPOSITION INDUCED AMORPHIZATION OF INTERFACES IN REFRACTORY METAL MULTILAYER SYSTEMS
A. F. Jankowski Apr. 1992 21 p Presented at the International Conference on Metallurgical Coatings and Thin Films, San Diego, CA, 6-10 Apr. 1992
(Contract W-7405-eng-48)
(DE92-008924; UCRL-JC-108820; CONF-920439-2) Avail: NTIS HC/MF A03

Multilayer thin films with refractory metal components are susceptible to solid state amorphization. It is an objective to minimize this interfacial reaction in order to ensure smooth layering and compositionally abrupt interfaces. These features are desirable for maximum reflectivity in x ray optic applications as projection lithography as well as neutron supermirror applications. This goal is achievable when the deposition process is optimized to thermalize the sputtered neutrals. Low working as pressures (less than 5 m Torr) and large source-to-substrate distances (greater than 12 cm) typically provide the proper conditions to form dense sputter deposits without adatom induced, interfacial amorphization. The interfaces of Mo/Si and Ni/Ti multilayers are examined with high resolution electron microscopy for samples sputter deposited under thermalized conditions. It is shown that it is possible to produce crystalline, refractory metal layers in the as-deposited structure without amorphous interfacial regions. DOE

N92-25216# Lawrence Livermore National Lab., CA.
TENSILE PROPERTIES OF THIN Au-Ni BRAZES BETWEEN STRONG BASE MATERIALS
M. C. Tolle and M. E. Kassner Dec. 1991 7 p
(Contract W-7405-eng-48)
(DE92-009677; UCRL-CR-109237) Avail: NTIS HC/MF A02

It has long been known that when relatively strong base materials are joined by thin, soft, interlayer metals such as with brazing or various solid state joining processes, the ultimate tensile strength (UTS) of the bond may be several factors higher than the UTS of the bulk, or unconstrained, interlayer metals. However, earlier work reported by the authors confirmed that delayed or 'creep' failure of the bond may occur at stresses much less than the UTS. It was found that for thin silver interlayers, prepared by brazing and physical vapor deposition (PVD), joining elastically deforming base materials (i.e., no measurable plastic deformation occurs in the base metal at the applied stresses), the ambient (and near-ambient) temperature time to failure is controlled by the creep rate of the silver interlayer which is determined by the effective stress within the interlayer. The plastic deformation within the interlayer causes cavity nucleation which continues until the concentration of nuclei is sufficiently high to lead to instability and eventual failure. The delayed failure may be accelerated by base material creep resulting from the effective stress in the base material. Plastic deformation in the base metal causes corresponding deformation in the interlayer, and cavities nucleate as with elastic base metal case. The delayed failure phenomenon was confirmed by the authors only for silver interlayers; other compositions were not tested. In this study, maraging steel was joined with an Au-Ni braze alloy with 57.5 at. pct. Au and 42.5 at. pct. Ni. The microstructure is expected to be a refined two-phase (spinodal) alloy with higher strength than the PVD silver of our previous investigation. DOE

N92-25217# Lawrence Livermore National Lab., CA.
RECENT ADVANCES IN UNDERSTANDING THE MECHANICAL BEHAVIOR OF CONSTRAINED THIN METALS IN BRAZES AND SOLID-STATE BONDS
M. E. Kassner, M. C. Tolle (Oregon State Univ., Corvallis.), R. S.

Rosen, G. A. Henshall, and J. W. Elmer Dec. 1991 12 p
(Contract W-7405-eng-48)
(DE92-009678; UCRL-CR-109238) Avail: NTIS HC/MF A03

Materials are frequently joined with thin metallic interlayers, often of lower strength than the base materials. These interlayers are often prepared by conventional brazing, but more recently materials that cannot be easily welded or brazed have been joined using solid state techniques. Here, the interlayers are prepared by a variety of advanced processes, and the solid state bonds often have superior mechanical performance to brazed assemblies. All soft-metal interlayer bonds have unique mechanical properties that are of both fundamental interest and of critical importance to designers. The mechanical properties of soft, thin, metal interlayer joints are analyzed in detail. Emphasis is placed on the unexpected observations of small plastic strain ductile failures in conventional tensile tests and low stress ductile tensile failures under constant, low, stresses. The mechanical behavior of these bond assemblies to (in-plane) shear and biaxial stress states is also described. The implications of these behaviors to service stress states and environments is also be discussed. Emphasis is placed on silver interlayers as these have generally been selected for experimental study. DOE

N92-25218# Lawrence Livermore National Lab., CA.
REAL SPACE MULTIPLE SCATTERING DESCRIPTION OF ALLOY PHASE STABILITY
P. E. A. Turchi and M. Sluiter 3 Feb. 1992 17 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract W-7405-eng-48)
(DE92-009680; UCRL-JC-107695; CONF-911202-65) Avail: NTIS HC/MF A03

We present a brief overview of the advanced methodology which has been recently developed to study phase properties of substitutional alloys, order-disorder phenomena and structural transformations. The approach is based on the real space version of the Generalized Perturbation Method, first introduced by Ducastelle and Gautier, within the Korringa-Kohn-Rostoker multiple scattering formulation of the Coherent Potential Approximation. Temperature effects are taken into account with a generalized meanfield approach, namely the Cluster Variation Method. The viability and the predictive power of such a scheme will be illustrated by a few examples, among them: (1) the ground state properties of alloys, in particular the ordering tendencies for a series of equiatomic bcc-based alloys; (2) the computation of alloy phase diagrams with the case of fcc and bcc-based Ni-Al alloys; (3) the calculation of antiphase boundary energies and interfacial energies; and (4) the stability of artificial ordered superlattices. DOE

N92-25220# Lawrence Livermore National Lab., CA.
MOLECULAR DYNAMICS STUDIES OF DEFECT PRODUCTION AND CLUSTERING IN ENERGETIC DISPLACEMENT CASCADES IN COPPER
T. DiazdelaRubia and W. J. Phythian (United Kingdom Atomic Energy Authority, Harwell, England) Mar. 1992 30 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract W-7405-eng-48)
(DE92-009683; UCRL-JC-109396; CONF-911111-38) Avail: NTIS HC/MF A03

We review recent molecular dynamics studies of displacement cascades in copper at energies from near threshold to 25 keV where nascent subcascades develop. We discuss the structure of the cascade region and present results on the dynamical evolution and lifetime of the cascades. We show that the defect and production efficiency in cascades follows a downward trend with energy, in good quantitative agreement with experiments. The cluster size distributions from the simulations show a strong recoil energy dependence. At low energy, loosely correlated vacancy distributions are generally observed. However, as the energy and hence the lifetime of the cascade increases, large vacancy clusters appear. Evidence is presented for the athermal collapse of a 25 keV cascade to a vacancy dislocation loop. Interstitial production mechanisms are identified. At all energies studied replacement collision sequences are observed. Moreover, vacancy-interstitial separation mechanisms based on ballistic clustering and dislocation loop punching from cascades are presented. DOE

N92-25259# Lawrence Livermore National Lab., CA.
COMPOSITION MONITORING OF ELECTRON BEAM MELTING PROCESSES USING DIODE LASERS
L. V. Berzins 20 Nov. 1991 5 p Presented at the 8th Conference on State-of-the-Art Electron Beam Melting and Refining, Reno, NV, 13-15 Nov. 1991
(Contract W-7405-eng-48)
(DE92-009527; UCRL-JC-107999; CONF-911189-3) Avail: NTIS HC/MF A01

Electron beam melting processes are used to produce high purity alloys for a wide range of applications. Real time monitoring of the alloy constituents, however, has historically been difficult. Absorption spectroscopy using diode lasers provides a means for measuring constituent densities, and hence alloy composition, in real time. Diode lasers are suggested because they are inexpensive and require little maintenance. There is increasing interest in the composition and quality control of titanium alloys used in aircraft parts. For this reason we describe a proposed system for composition monitoring of titanium alloys. Performance and cost of the proposed system is addressed. We discuss the applicability of this approach to other alloys. DOE

N92-25265*# California Univ., Santa Barbara. Quantum Inst.
AN INVESTIGATION OF THE EFFECT OF SURFACE IMPURITIES ON THE ADSORPTION KINETICS OF HYDROGEN CHEMISORBED ONTO IRON Annual Status Report, 1 Jan. - 31 Dec. 1991
Mickey R. Shanabarger 31 Dec. 1991 22 p
(Contract NCC2-63)
(NASA-CR-190138; NAS 1.26:190138) Avail: NTIS HC/MF A03

The goal was to develop an understanding of heterogeneous kinetic processes for those molecular species which produce gaseous hydrogen degradation of the mechanical properties of metallic structural materials. Although hydrogen degradation of metallic materials is believed to result from dissolved protonic hydrogen, the heterogeneous hydrogen interface transport processes often dominate the kinetics of the degradation process. The initial step in the interface transport process is the dissociative chemisorption of the molecular species at the metal surface followed by hydrogen absorption into and transport through the bulk. Modern advanced aerospace applications often require the use of structural materials in high pressure hydrogen environments at temperatures which range from low cryogenic temperatures to very high temperatures (1300 K and greater). Materials proposed for these applications, such as the titanium aluminides, beta-titanium alloys, nickel- and cobalt-based superalloys, molybdenum-rhenium alloys, beryllium, and various beryllides, need to possess a high degree of immunity from hydrogen induced degradation of mechanical properties. In the present program, the interaction of hydrogen with the surfaces of alpha-2 (Ti3Al) titanium aluminide, gamma (TiAl) titanium aluminide, and beryllium were studied. The interaction of low pressure hydrogen with gamma titanium aluminide and beryllium was found to be relatively weak, in the sense that adsorption leads to a low surface concentration of dissociated hydrogen, i.e., the chemisorption process is reversible at room temperature (300 K) for gamma titanium aluminide and the sticking coefficient for chemisorption is extremely small for beryllium. Hydrogen was found to interact readily with alpha-2 titanium aluminide to form a stable surface hydride at 300 K. These results correlate well with other recent studies which show that the mechanical properties for alpha-2 titanium aluminide are readily degraded in hydrogen while gamma titanium aluminide exhibits less degradation and beryllium essentially no degradation. The interaction of oxygen with the surface of these materials has been studied, also, in the present program. Author

N92-25284# Technische Univ., Delft (Netherlands).
THE MECHANISM OF THE OXIDATION OF NICKEL ALUMINIUM COATING ALLOYS Ph.D. Thesis
Peter Andre vanManen 1991 159 p
(ETN-92-91293) Avail: NTIS HC/MF A08

Research aimed at a better understanding of the mechanisms by which yttrium and platinum improve the oxidation resistance of NiAl alloys is described. Oxidation experiments were carried out with beta-NiAl, Pt20, Ni30 Al50 and beta-NiAl with 0.5 percent yttrium. The temperature range from 900 to 1200 C in which the experiments were performed, complies with commonly encountered temperatures in gas turbine applications. The application of cylcic voltammetry on a high temperature system is described. ESA

N92-25285# Technische Univ., Delft (Netherlands). Powder Metallurgy Group.
EXTRUSION OF Al-Si-X ALLOYS PREPARED FROM RAPIDLY SOLIDIFIED POWDERS Ph.D. Thesis
Jie Zhou 1991 188 p Sponsored by Netherlands Organization for Scientific Research and Innovative Research Program
(ETN-92-91294) Avail: NTIS HC/MF A09

Research to provide elemental and practical knowledge of extrusion as guide to better understanding of the process as applied to Powder Metallurgy (PM) Al-Si-X alloys is presented. Focus is on the extrusion of two newly designed AlSi alloys both produced by means of air atomization without covering peripheral areas: Al-20Si-3Cu-1Mg and Al-20Si-7.5Ni-3Cu-1Mg. A description of extrusion as a thermally activated process and the influences of extrusion variables on pressure requirement and the friction at the mutual sliding interface (between billet and container) is given. The underlying mechanisms determining the mechanical behavior of the second PM alloy above, which involves the complicated superposition of several strengthening mechanisms, including internal boundary (grain, subgrain and original powder particle boundaries), solid solution, precipitation and dispersion strengthening, are discussed. ESA

N92-25363 National Physical Lab., Teddington (England). Div. of Materials Metrology.
SURFACE TENSION OF PURE METALS
B. J. Keene Nov. 1991 173 p
(NPL-DMM(A)-39; ISSN-0143-7313; ETN-92-91375) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A literature survey of the experimentally determined values for the surface tension of molten pure metals is presented. The survey was carried out in order to provide an assessed data base for use with a mathematical model currently being developed to predict the surface tension of molten metal alloys. ESA

N92-25441# California Univ., Berkeley. Lawrence Berkeley Lab.
THE STRUCTURAL DEPENDENCE OF WORK HARDENING IN LOW CARBON STEELS Ph.D. Thesis
P. E. Johnson Dec. 1991 128 p
(Contract DE-AC03-76SF-00098)
(DE92-010303; LBL-31670) Avail: NTIS HC/MF A07

The influence of the dislocation cell structure on the work hardening behavior of low carbon steel sheets was investigated. Specimens were prestrained at low temperature to suppress cell formation and their subsequent behavior was compared with results of isothermal reference tests. It was found that the extent of cell development has little or no influence on the plastic behavior at room temperature and below. Interrupted temperature, tensile-shear tests demonstrated further that the transient behavior induced by loading path changes is also not strongly associated with the cell walls. In-situ straining studies indicate that the factor controlling the flow stress at room temperature is the limited mobility of screw dislocations moving the cell interiors, and not dislocation interactions with the cell walls. The unique properties of a/2(111) screw dislocations are known to dominate low temperature deformation behavior in bcc metals. The current work indicates that these dislocations may still control the flow stress at intermediate temperatures, even in the presence of a developed cell structure. DOE

N92-25482# Pacific Northwest Lab., Richland, WA.
CORROSION STUDIES OF CARBON STEEL UNDER IMPINGING JETS OF SIMULATED SLURRIES OF NEUTRALIZED CURRENT ACID WASTE (NCAW) AND NEUTRALIZED CLADDING REMOVAL WASTE (NCRW)
H. D. Smith and M. R. Elmore Jan. 1992 76 p
(Contract DE-AC06-76RL-01830)
(DE92-007605; PNL-7816) Avail: NTIS HC/MF A05

Plans for the disposal of radioactive liquid and solid wastes presently stored in double-shell tanks at the Hanford Site call for retrieval and processing of the waste to create forms suitable for permanent disposal. Waste will be retrieved from a tank using a submerged slurry pump in conjunction with one or more rotating slurry jet mixer pumps. Pacific Northwest Laboratory (PNL) has conducted tests using simulated waste slurries to assess the effects of a impinging slurry jet on the corrosion rate of the tank wall and floor, an action that could potentially compromise the tank's structural integrity. Corrosion processes were investigated on a laboratory scale with a simulated neutralized cladding removal waste (NCRW) slurry and in a subsequent test with simulated neutralized current acid waste (NCAW) slurry. The test slurries simulated the actual NCRW and NCAW both chemically and physically. The tests simulated those conditions expected to exist in the respective double-shell tanks during waste retrieval operations. Results of both tests indicate that, because of the action of the mixer pump slurry jets, the waste retrieval operations proposed for NCAW and NCRW will moderately accelerate corrosion of the tank wall and floor. Based on the corrosion of initially unoxidized test specimens, and the removal of corrosion products from those specimens, the maximum time-averaged corrosion rates of carbon steel in both waste simulants for the length of the test was approximately 4 mil/yr. The protective oxide layer that exists in each storage tank is expected to inhibit corrosion of the carbon steel. DOE

N92-25527# National Inst. of Standards and Technology, Boulder, CO. Materials Reliability Div.
REVIEW OF CRYOGENIC MECHANICAL AND THERMAL PROPERTIES OF Al-Li ALLOYS AND ALLOY 2219
N. J. Simon, E. S. Drexler, and R. P. Reed Dec. 1991 196 p Sponsored in part by AF
(PB92-149723; NISTIR-3971; B91-0236) Avail: NTIS HC/MF A09

The review of cryogenic mechanical and thermal properties presented is part of a broader NIST program to assess new high strength Al-Li alloys for use in the cryogenic tankage of the Advanced Launch System (ALS). The purpose of the NIST program has been to assess the relative suitability of high strength Al-Li alloys and alloy 2219 for use in ALS cryogenic tanks. The cryogenic data on Al-Li alloys 8090, 2090, WL049, and Al alloy 2219 are summarized. Properties covered in the survey are tensile strength, yield strength, elongation, fracture toughness, elastic constants, specific heat, thermal conductivity, and thermal expansion. Author

N92-25645# Argonne National Lab., IL.
ROLE OF ATMOSPHERIC CORROSION OF ALUMINUM ALLOYS IN VIABILITY OF INTRINSIC-SURFACE METHODS FOR TAGGING MILITARY HARDWARE
P. S. Maiya and T. F. Kassner Nov. 1991 23 p
(Contract W-31-109-eng-38)
(DE92-009925; ANL/ACTV-91/6) Avail: NTIS HC/MF A03

A primary requirement for authentication of tags for military equipment desigated as treaty-limited items (TLIs) is that the surface topograhy of the tag area be maintained after exposure to a variety of atmospheric conditions over many years. This report summarizes the chemical and physical properties of atmospheric as they relate to localized corrosion of aluminum and aluminum alloys. The role of impurity species that exacerbate corrison, and

that hence may interfere with tag verification, is discussed. Because exposure times for the tag materials are much longer than those practical in laboratory experiments, it is important to understand the kinetics of processes occurring in these alloys and the viability of various protection schemes. General principles and limitations of testing in natural atmospheres and in the laboratory are discussed. Corrosion results indicate that the tag surface must be protected, and a tag protection scheme is proposed. DOE

N92-25646# Allied Bendix Aerospace, Kansas City, MO.
PHOSPHORUS-31 NMR ANALYSIS OF GOLD PLATING BATHS
R. E. Smith Mar. 1992 9 p
(Contract DE-AC04-76DP-00613)
(DE92-010069; KCP-613-4665) Avail: NTIS HC/MF A02

This report describes the nuclear magnetic resonance (NMR) analysis of gold plating baths in the Micro-Miniature Electronic Assembly department of Allied-Signal Inc., Kansas City Division (KCD). The baths were analyzed for phosphorylated components. In freshly prepared gold plating baths in this department the principle compound observed is aminotrimethyl-phosphonate, or ATMP. As the bath is used in production, the ATMP breaks down; and new compounds, aminodimethylphosphonate (ADMP), aminomonomethylphosphonate, (AMMP), and inorganic phosphate (H2PO4(-), are formed. The NMR method has been used for almost three years to monitor the concentrations of the ATMP and breakdown products. In a previous report, results from January through October 1988 were reported. In this report, results from November 1988 through January 1991 are given. DOE

N92-25750# Lawrence Livermore National Lab., CA.
BTI WARHEAD
28 Aug. 1991 139 p Prepared in cooperation with Alliant Techsystems, Inc., Brooklyn Park, MN
(Contract W-7405-eng-48)
(DE92-009701; UCRL-CR-109506) Avail: NTIS HC/MF A07

There is little data on the dynamic properties of tantalum in the strain rate regime encountered during explosive formed projectiles (EFP) information. Laboratory techniques can only achieve rates of 10,000 inches/inch/sec. EFP formation strain rates are ten to a hundred times greater. There is some evidence that at these very high rates the effect strain rate has on mechanical properties becomes very marked. Thus, in order to conduct an adequate experiment, strain rates comparable to EFP formation strain rates were required. There are other extreme phenomenon peculiar to EFP formation such as explosive shock effects. These include extremely high temperatures due to the high strain rates and pressures involved. There is no available laboratory technique to produce all all of these conditions at the proper levels. To provide all the phenomenon of interest at realistic levels, including explosive shock, it was decided to launch and form actual EFP's from the materials of interest. These EFP's were then soft recovered and analyzed. In order to examine the widest variety of material response, a spectrum of EFP designs were employed within each material. One design produced a short EFP, which would have a minimum material deformation. Another design produced a longer EFP, with greater deformation but no material failure. This was designated the medium design. The last design produced an EFP which failed dynamically during the formation, providing a sample of material in the most extreme condition. This was the long design. DOE

N92-25796# Oak Ridge National Lab., TN.
IRIDIUM-ALLOY PROCESSING EXPERIENCE IN FY 1990
E. K. Ohriner Nov. 1991 24 p
(Contract DE-AC05-84OR-21400)
(DE92-010519; ORNL/TM-11878) Avail: NTIS HC/MF A03

Iridium-alloy blanks and foil are produced at the Oak Ridge National Laboratory for use as fuel cladding material in radioisotope thermoelectric generators for space power sources. Until 1984, the material was produced from small, 500-g drop castings. A new process has been developed in which consumable electrodes of about 10 kg are melted, extruded, and then rolled to produce the sheet products. The work performed during FY 1990 included the consumable-electrode arc melting of four ingots and the extruding and rolling to sheet of four billets. Significant improvements made in the extruding and arc-melting processes during FY 1989 have been demonstrated to dramatically increase the rate of blank acceptance in nondestructive evaluations. Efforts to improve the rolling practice and to better characterize intermetallic particle distributions in the sheet are also described. DOE

N92-25951# National Inst. for Fusion Science, Nagoya (Japan).
COMPARISON OF IONIZATION RATE COEFFICIENTS OF IONS FROM HYDROGEN THROUGH NICKEL
Takako Kato, Kuniaki Masai, and M. Arnaud Sep. 1991 231 p
(DE92-768075; NIFS-Data-14) Avail: NTIS HC/MF A11

Ionization rate coefficients based on several empirical formulae are compared with each other for ions from Hydrogen to Nickel. The coefficients are shown illustratively, and the differences are discussed. DOE

N92-25985# Lawrence Livermore National Lab., CA.
PHASE FORMATION AT BONDED VANADIUM AND STAINLESS STEEL INTERFACES
T. S. E. Summers Jan. 1992 28 p
(Contract W-7405-eng-48)
(DE92-008984; UCRL-ID-109632) Avail: NTIS HC/MF A03

The interface between vanadium bonded to stainless steel was studied to determine whether a brittle phase formed during three joining operations. Inertia friction welds between V and 21-6-9 stainless steel were examined using TEM. In the as-welded condition, a continuous, polygranular intermetallic layer about 0.25 micron thick was present at the interface. This layer grew to about 50 microns thick during heat treatment at 1000 C for two hours. Analysis of electron diffraction patterns confirmed that this intermetallic was the omega phase. The interface between vanadium and type 304, SANDVIK SAF 2205, and 21-6-9 stainless steel bonded by a co-extrusion process had intermetallic particles at the interface in the as-extruded condition. Heat treatment at 1000 C for two hours caused these particles to grow into continuous layers in all three cases. Based on the appearance, composition and hardness of this interfacial intermetallic, it was also concluded to be the omega phase. Bonding V to type 430 stainless steel by co-extrusion caused V-rich carbides to form at the interface due to the higher concentration of C in the type 430 than in the other stainless steels investigated. The carbide particles initially present grew into a continuous layer during a two-hour heat treatment at 1000 C. Co-hipping 21-6-9 stainless steel tubing with V rod resulted in slightly more concentric specimens than the co-extruded ones, but a continuous layer of the omega phase formed during the hipping operation. This brittle layer could initiate failure during subsequent forming operations. The vanadium near the stainless steel interface in the co-extruded and co-hipped tubing in some cases was harder than before heat treatment. It was concluded that this hardening was due to thermal straining during cooling following heat treatment and that thermal strains might present a greater problem than seen here when longer tubes are used in actual applications. DOE

N92-26001# Technische Univ., Delft (Netherlands).
PHASE TRANSFORMATIONS IN IRON-BASED INTERSTITIAL MARTENSITES Ph.D. Thesis
Cheng Liu 1990 236 p
(ETN-92-91701) Avail: NTIS HC/MF A11

The (pre)precipitation phenomena occurring in tempering of iron carbon (FeC), iron nitrogen (FeN); iron nickel nitrogen (FeNiN), and iron carbon nitrogen (FeCN) martensites is studied. Martensite specimens were prepared from pure iron or pure iron-nickel alloy by gaseous carburizing, nitriding, and carbonitriding in gas mixtures at temperatures between 920 and 1120 K and subsequent quenching in brine and liquid nitrogen. A survey of literature data for the lattice parameters of FeC and FeN martensites and austenites is given. The aging phenomena in pure iron-nitrogen (5.5 at. N) and iron-carbon (5.1 at. C) martensites at room temperature, is studied by tracing changes of the X ray diffraction

profiles of doublet reflections of the martensites' crystal parameter (002)/(200). The lattice changes of the FeC martensite was studied in the first 50 hours of aging. The structural evolution of iron-carbon martensite (5 at.C) studied by x ray diffraction. For individual titles, see N92-26002 through N92-26009.

N92-26002# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
LATTICE PARAMETERS OF IRON-CARBON AND IRON-NITROGEN MARTENSITES AND AUSTENITES
Cheng Liu, A. Boettger, T. H. deKeijser, and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 7-17 Repr. from Scripta Met. et Mat., v. 24, 1990 p 504-514 (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The existing lattice parameter data of pure iron-carbon and pure iron-nitrogen as-quenched martensic specimens are presented. The relations between lattice parameters and interstitial content are given in two ways: as a function of the atomic percentage of interstitial and as a linear function of the number of interstitials per hundred iron atoms. It is assumed that in first order approximation, the lattice parameter is linearly dependent on the number of solute atoms in the unit cell. As the temperatures pertaining to the lattice-parameter data are not always reported in the literature, it is assumed that these data were obtained at room temperature. The comparison between carbon and nitrogen martensites suggests that in the martensites the size of a nitrogen atom is larger than that of carbon. From the calculated electronic structure around the intensities it follows that for the same displacement of the two first nearest neighbor iron atoms the structure is more stable for dissolved carbon than dissolved nitrogen. Slight differences exist between both martensites. ESA

N92-26003# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
LATTICE CHANGES OF IRON-NITROGEN MARTENSITE ON AGING AT ROOM TEMPERATURE
Cheng Liu, N. M. vanderPers, A. Boettger, T. H. deKeijser, and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 19-47 Submitted for publication (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The aging behavior of iron-nitrogen martensite at about 297 K was investigated by X ray diffractometry. The changes in the diffraction line profiles of the (002) and (200) crystal parameter groups were observed. Martensitic specimens were prepared by gaseous nitriding of pure iron in a mixture of NH and H, followed by quenching in brine and subsequently in liquid nitrogen. The aging process can be divided into two stages. Firstly a redistribution of nitrogen atoms in the martensite matrix occurs in three ways: segregation of nitrogen to lattice defects, transfer of a small amount of nitrogen from a/b to c type octahedral interstices and local enrichment in an ordered way of the majority of the nitrogen atoms. Secondly, formation of incoherent alpha-Fe16N2 nitride takes place. Within the range of aging times employed the diffraction by the residual austenite did not change. ESA

N92-26004# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
LATTICE CHANGES OF IRON-CARBON MARTENSITE ON AGING AT ROOM TEMPERATURE
Cheng Liu, N. M. vanderPers, A. Boettger, T. H. deKeijser, and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 49-73 Submitted for publication (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The aging behavior of iron-carbon martensite at about 297 K was studied by X ray diffractometry. The changes in the diffraction line profiles of the (002) and (200) crystal lattice groups were observed. Martensitic specimens are prepared by gaseous carburizing of pure iron in a mixture of H2 and CO, followed by quenching in brine and subsequently in liquid nitrogen. The aging process can be divided into two stages. Firstly a redistribution of carbon atoms on the martensite matrix occurs in four ways: segregation of carbon to lattice defects, transfer of carbon from the a/b type to c type octahedral interstices in the bulk of the martensite, transfer of carbon from c type to a/b type interstices at locations of significant stress variation, and formation of carbon enrichments (clusters) in the matrix in which the majority of the carbon atoms is involved. Secondly coarsening of the clusters occurs leading to diffraction by the matrix independent of the clusters. Within the range of aging times employed the diffraction by the retained austenite did not change. ESA

N92-26005# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
ANALYSIS OF NONISOTHERMAL TRANSFORMATION KINETICS: TEMPERING OF IRON-CARBON AND IRON-NITROGEN MARTENSITES
E. J. Mittemeijer, Cheng Liu, P. J. vanderSchaaf, C. M. Brakman, and B. M. Korevaar *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 77-95 Repr. from Metall. Trans. A, v. 19A, 1988 p 925-932 (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

A powerful method for the analysis of solid state transformation kinetics is discussed. It is based on nonisothermal analysis where the temperature corresponding to a fixed stage of transformation is measured as a function of heating rate. The adoption of a specific kinetic model is not required for valid application of this method, so the constraints imposed on so called Kissinger like procedures are removed. The method was applied to study and to compare the tempering kinetics of iron-carbon martensite and iron-nitrogen martensite. Dilatometry and differential scanning calorimetry were employed. Precipitation processes such as segregation and clustering of interstitials could be distinguished. In contrast with iron-carbon martensite, no indications were obtained for clustering of interstitials in iron-nitrogen martensite. The precipitation stages have activation energies of 75 to 85 kJ/mole, which are ascribed to volume diffusion of interstitials. The precipitation of the transition carbide/nitride occurs with an activation energy of 110 to 125 kJ/mole, which is ascribed to pipe diffusion of iron. The precipitation of the equilibrium carbide/nitride is associated with an activation energy of 195 to 205 kJ/mole which is ascribed to combined pipe and volume diffusion of iron. ESA

N92-26006# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
THE TEMPERING OF IRON-CARBON MARTENSITE: DILATOMETRIC AND CALORIMETRIC ANALYSIS
Cheng Liu, C. M. Brakman, B. M. Korevaar, and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 97-127 Repr. from Metall. Trans. A., v. 19A, 1988 p 2415-2426 (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The aging behavior of iron-carbon martensite between -190 and 450 C was investigated. The quantitative analysis of the corresponding changes in volume and enthalpy was carried out. A method to determine activation energies of the occurring solid state transformations by performing nonisothermal measurements of some physical property of the specimen was described. Martensic specimens were prepared by carburizing pure iron and quenching in brine and liquid nitrogen. The dilatometric and colorimetric experiments were supplemented with microhardness measurements. At least five different stages of structural change could be distinguished. They are quantitatively analyzed in terms of their effects on volume and enthalpy: transformation of retained austenite into martensite, redistribution of carbon atoms, precipitation of transition carbide, decomposition of retained austenite, and conversion of transition carbide into cementite. ESA

N92-26007# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
THE TEMPERING OF IRON-NITROGEN MARTENSITE: DILATOMETRIC AND CALORIMETRIC ANALYSIS
Cheng Liu and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 129-163 Repr. from Metall. Trans. A., v. 19A, 1990 p 13-26 (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The aging behavior of iron-nitrogen martensic alloys (0.8 to 7.0 at. percent N) between -190 and 450 C was investigated. The quantitative analysis of the corresponding changes in volume and enthalpy was carried out. Martensic specimens were prepared by gaseous nitriding of pure iron in a mixture of NH3 and H2 and subsequent quenching in brine and liquid nitrogen. Both X ray diffraction analysis and metallography were used for interpretation of the structural changes. The analysis of the transformation kinetics was achieved by employing a range of heating rates. At least five different stages of structural change could be distinguished. They were quantitatively analyzed in terms of their effects on volume and enthalpy: transformation of retained austenite into martensite (between -160 and -40 C); segregation and 'ordering' of nitrogen, atoms (below 100 C); precipitation of incoherent alpha nitride (between 100 and 220 C), conversion of alpha nitride into gamma' nitride (between 220 and 290 C), decomposition of retained austenite (between 240 and 350 C). Differences with the tempering behavior of analogous iron-carbon martensites are discussed. ESA

N92-26008# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
THE TEMPERING OF FeNiN MARTENSITE
Cheng Liu, A. Boettger, and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 167-194 Submitted for publication (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The tempering behavior of ternary iron-nickel-nitrogen martensic specimens (approx. 13.5 at. percent Ni, approx. 4.7 at. percent N, approx. 4.9 atoms per 100 metal atoms) was investigated in the temperature range 270 to 670 K. The analysis of the corresponding changes in the crystalline structure (X ray diffraction), volume (dilatometry) and enthalpy (calorimetry) was carried out. At least three stages of structural changes could be distinguished: redistribution of nitrogen atoms, involving segregation and formation of nitrogen enrichments, occurs at temperatures up to 370 K; precipitation of gamma'-(Fe, Ni)4N sub(1-x) nitride takes place in the temperature range 370 to 430 K; and coarsening of the gamma' precipitates and decomposition of a part of the retained austenite occur at temperatures above 430 K. From a comparison with the tempering behavior of a binary iron-nitrogen martensic alloy containing a similar amount of interstitials it was concluded that the presence of nickel suppresses the development of the intermediate alpha''(Fe, Ni) 16 N2 nitride and advances the precipitation of gamma' nitride. ESA

N92-26009# Technische Univ., Delft (Netherlands). Lab. of Metallurgy.
THE TEMPERING OF IRON-CARBON-NITROGEN MARTENSITES
Cheng Liu, A. Boettger, and E. J. Mittemeijer *In its* Phase Transformations in Iron-Based Interstitial Martensites 1990 p 197-230 Submitted for publication (For primary document see N92-26001 16-26)
Avail: NTIS HC/MF A11

The tempering behavior of ternary FeCN martensitic specimens, with a total amount of interstitials of about 5.5 at. percent and carbon and nitrogen contents between about 1.5 at. percent and 3.9 at. percent, was investigated in the temperature range of 100 to 830K. The analysis of the corresponding changes in crystalline structure (X ray diffraction), volume (dilatometry), hardness and enthalpy (calorimetry) revealed that the following processes occurred: martensitic transformation of retained austenite between 110 and 200 K; redistribution of interstitials in martensite up to 370 K; formation of nitrogen containing alpha precipitates and carbon containing epsilon/eta precipitates between 370 and 450 K; conversion of alpha' nitride into gamma' nitride and coarsening of epsilon/eta carbide between 450 and 560 K; decomposition of retained austenite above 540 K; conversion of epsilon/eta carbide into cementite above 570 K. Significant precipitation of carbon and nitrogen together, as nitrocarbides or carbonitrides, was not observed. The tempering behavior of binary FeC and FeN alloys of similar interstitial content was compared. From the results it was concluded for the ternary FeCN alloy, that the transformation of the transition nitride (alpha') into the 'equilibrium' nitride (gamma') is advanced and that the precipitation of the transition nitride (epsilon/eta) and its conversion into the 'equilibrium' carbide (cementite) and the decomposition of retained austenite are retarded. ESA

N92-26027# Connecticut Univ., Storrs. Dept. of Metallurgy.
FATIGUE OF FERRITIC AND AUSTENITIC STEELS
A. J. McEvily 1991 19 p
(Contract DE-FG02-84ER-45109)
(DE92-011577; DOE/ER-45109/T2) Avail: NTIS HC/MF A03

One aim of this research program has been to increase our understanding of the mechanisms of fatigue crack growth as influenced by such parameters as the specific material, crack length, R-ratio, overloads, temperature, and the environment. A second objective has been to utilize this understanding in the development of semi-empirical quantitative methods for the prediction of fatigue crack growth behavior. Although there are still many questions remaining concerning fatigue crack growth, we feel that some significant progress in meeting these two objectives has been made. DOE

N92-26093# Purdue Univ., West Lafayette, IN. Heat Transfer Lab.
UNIDIRECTIONAL SOLIDIFICATION OF A BINARY MODEL ALLOY AND THE EFFECTS OF INDUCED FLUID MOTION
D. G. Neilson and F. P. Incropera Jan. 1992 312 p
(Contract DE-FG02-87ER-13759)
(DE92-010022; DOE/ER-13759/5) Avail: NTIS HC/MF A14

Unidirectional solidification (UDS) of a binary alloy under conditions for which large-scale convection results from a compositionally induced density inversion in the mushy region was the focus of the study. A unique aspect of this phase change process is the occurrence, within the mushy region, of discrete, vertically aligned sites which are devoid of solid. These channels act as pathways of least resistance for the less dense interdendritic fluid to escape from the mushy zone to the overlying bulk liquid. As the solid front advances upward, solids form within the channels but their composition and crystalline structure is eutectic, and thus the channels become freckle segregates. Moreover, the less dense and compositionally diluted interdendritic fluid advected via the channels into the bulk liquid alters the bulk composition thereby promoting negative macrosegregation. To gain an improved understanding of the transport phenomena and its effects on solidification, a combined numerical and experimental study was adopted. Both phases of research employed the dendrite-forming aqueous NH2Cl model alloy. Two-dimensional numerical simulations, which used a continuum formulation to derive conservation equations for mass, momentum, energy and species, predicted channel growth to begin at the liquidus front and, due to a localized freezing point depression, to propagate downward. DOE

N92-26157# National Inst. of Standards and Technology, Gaithersburg, MD. Metallurgy Div.
WELD AND HEAT AFFECTED ZONE CRACK ARREST FRACTURE TOUGHNESS OF AAR TC128 GRADE B STEEL
G. E. Hicho and D. E. Harne Feb. 1992 25 p
(Contract DTRF53-90-X-0051)
(PB92-164698; NISTIR-4767; Rept-25) Avail: NTIS HC/MF A03

Weld and heat affected zone (HAZ) crack arrest fracture toughness were determined for welded plates of normalized AAR

TC128 grade B steel, currently used in appropriate tank cars that carry hazardous materials. The plates were joined under laboratory conditions and stress relieved using the recommended Association of American Railroads (AAR) welding procedures. In the calculation of the crack arrest fracture toughness, the yield strength at the test temperature is required in the appropriate equations. Hence weld metal tensile specimens were prepared from the joined plates and tested at temperatures ranging from -51 to -18 C. Weld and HAZ crack arrest fracture toughness specimens were prepared and tested at -51 C. Crack arrest fracture toughness results indicated that both the weld metal and the HAZ for the welded normalized and stress relieved AAR TC128 grade B steel were highly resistant to crack initiation and possessed the ability to arrest a propagating crack. Author

N92-26164# Westinghouse Savannah River Co., Aiken, SC.
COHERENT OPTICAL METHODS FOR METALLOGRAPHY
M. J. Pechersky 1991 10 p Presented at the 24th Annual Convention of the International Metallographic Society, Inc.: Structure-Property Relationships and Correlations With the Degradation of Engineering Materials, Monterey, CA, 29 Jul. - 1 Aug. 1991
(Contract DE-AC09-89SR-18035)
(DE92-009472; WSRC-MS-91-321; CONF-910767-5) Avail: NTIS HC/MF A02

Numerous methods based on coherent optical techniques have been developed over the past two decades for nondestructive evaluation, vibration analysis and experimental mechanics. These methods have a great deal of potential for the enhancement of metallographic evaluations and for materials characterization in general. One such technique described in this paper is the determination of the material damping factors in metals. Damping loss factors as low as 10-5 were measured on bronze and aluminum specimens using a technique based on laser vibrometry. Differences between cast and wrought bronze were easily distinguishable as well as the difference between the bronze and aluminum. Other coherent optical techniques may be used to evaluate residual stresses and to locate and identify microcracking, subsurface voids and other imperfections. These techniques and others can serve as a bridge between microstructural investigations and the macroscopic behavior of materials. DOE

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N92-25156# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
CATALYTIC SYNTHESIS OF SILICON CARBIDE PRECERAMIC POLYMERS: POLYCARBOSILANES
D. H. Berry Nov. 1991 7 p
(Contract DE-FG02-91ER-14173)
(DE92-008878; DOE/ER-14173/1) Avail: NTIS HC/MF A02

Polycarbosilanes are the most successful and widely studied class of polymer precursors for silicon carbide, but traditional methods for thier synthesis are inefficient and nonselective. This project is focused on developing transition metal catalysts for the synthesis of polycarbosilanes and other perceramic polymers. In recent work we have developed the first homogeneous transition metal catalysts for the dehydrogenative coupling of simple alkyl silanes to oligomeric and polymeric carbosilanes, H-((SiR2)CR(prime)(sub 2))(sub n)-SiR3. Future work will help elucidate the mechanism of the catalytic process, explore the use of hydrogen acceptors as reaction accelerators, and develop new and more active catalysts. DOE

N92-25195*# Howard Univ., Washington, DC. Dept. of Physics.
DEVELOPMENT, PREPARATION, AND CHARACTERIZATION OF HIGH-PERFORMANCE SUPERCONDUCTING MATERIALS FOR SPACE APPLICATIONS Progress Report
Arthur N. Thorpe and Aaron Barkatt (Catholic Univ. of America, Washington, DC.) Dec. 1991 59 p
(Grant NAG5-1017)
(NASA-CR-190205; NAS 1.26:190205) Avail: NTIS HC/MF A04

The preparation of high-temperature superconducting ceramics in bulk form is a major challenge in materials science. The current status of both partial melting and melt quenching techniques, with or without an intermediate powder processing stage, is described in detail, and the problems associated with each of the methods are discussed. Results of studies performed on melt-processed materials are reported and discussed. The discussion places emphasis on magnetization and on other physical properties associated with it, such as critical current density, levitation force, and flux creep. The nature of structural features which give rise to flux pinning, including both small and large defects, is discussed with reference to theoretical considerations. The rates of flux creep and the factors involved in attempting to retard the decay of the magnetization are surveyed. Author

N92-25223# Oak Ridge National Lab., TN.
THE COST OF SILICON NITRIDE POWDER: WHAT MUST IT BE TO COMPETE?
S. Das and T. R. Curlee Feb. 1992 55 p
(Contract DE-AC05-84OR-21400)
(DE92-008710; ORNL-6694) Avail: NTIS HC/MF A04

The ability of advanced ceramic components to compete with similar metallic parts will depend in part on current and future efforts to reduce the cost of ceramic parts. This paper examines the potential reduction in part cost that could result from the development of less expensive advanced ceramic powders. The analysis focuses specifically on two silicon nitride engine components: roller followers, and turbocharger rotors. The results of the process-cost models developed for this work suggest that reductions in the cost of advanced silicon nitride powder from its current level of about $20 per pound to about $5 per pound will not in itself be sufficient to lower the cost of ceramic parts below the current cost of similar metallic components. This work also examines the possibility of whether of not combinations of lower-cost powders and further improvements in other key technical parameters, to which costs are most sensitive, could push the cost of ceramics below the cost of metallics. Although these sensitivity analyses are reflective of technical improvements that are very optimistic, the resulting part costs are estimated to remain higher than similar metallic parts. Our findings call into question the widely-held notion that the cost of ceramic components must not exceed the cost of similar metallic parts if ceramics are to be competitive. Economic viability will ultimately be decided not on the basis of which part is less costly, but on an assessment of the marginal costs and benefits provided by ceramics and metallics. This analysis does not consider the benefits side of the equation. Our findings on the cost side of the equation suggest that the competitiveness of advanced ceramics will ultimately be decided by our ability to evaluate and communicate the higher benefits that advanced ceramic parts may offer. DOE

N92-25299# Technische Univ., Delft (Netherlands).
LASER CHEMICAL VAPOR PRECIPITATION OF CERAMIC POWDERS Ph.D. Thesis
Robertus Antonius Bauer 1991 192 p Sponsored in part by Ministry of Economic Affairs and DSM
(ETN-92-91277) Avail: NTIS HC/MF A09

The formation of optimal silicon nitride powders is studied by using as synthesis technique Laser Chemical Vapor Precipitation (LCVP). The combination of gas phase reaction and laser heating technique results in an optimal control of the particle sizes and, because it is a cold wall, in a strong reduction of impurities. Reactor development and other experimental aspects are described and laser synthesis of the following are detailed: low agglomerated Si3N4 powders from SiH2Cl2; Si3N4 fibers from SiH2Cl2 and NH3;

and Si3N4 powders by NH3 excitation. The use of sensitizers in the formation of Si and Si3N4 powders from chlorinated silanes in CO2 laser reactions is addressed. SiF4 as silicon precursor for the synthesis of Si3N4 by LCVP is reported. ESA

N92-25310 National Physical Lab., Teddington (England). Div. of Materials Metrology.
THE COMBINED EFFECT OF SPEED AND HUMIDITY ON THE WEAR AND FRICTION OF SILICON NITRIDE
M. G. Gee and D. Butterfield Sep. 1991 70 p Original contains color illustrations
(NPL-DMM(A)-36; ISSN-0959-2423; ETN-92-91374) Copyright
Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A series of ball-on-ring wear tests was performed on sintered silicon nitride to investigate a discrepancy in the literature on the effect of humidity on the wear of silicon nitride. A range of different testing speeds was used and the humidity of the tests held at either less than 5 percent RH or at 50 percent RH. It was found that at the lowest speed that was used, the wear rates for the two different humidities were fairly similar. As the speed increased there was a maximum in the wear rate for the high humidity tests, and a minimum for the low humidity tests, with wear rates for the low humidity tests much lower than the high humidity tests. At high speeds, the wear rate for the low humidity tests was much lower than for the high humidity tests. The main mechanism of wear was the tribochemical oxidation of the silicon nitride to form silicon oxide. ESA

N92-25348*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CYCLOPENTADIENE EVOLUTION DURING PYROLYSIS-GAS CHROMATOGRAPHY OF PMR POLYIMIDES
William B. Alston, Richard E. Gluyas, and William J. Snyder (Bucknell Univ., Lewisburg, PA.) 1992 23 p Presented at the 4th International Conference on Polyimides, Ellenville, NY, 30 Oct. - 1 Nov. 1991; sponsored in part by Society of Plastic Engineers
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-105629; E-6971; NAS 1.15:105629;
AVSCOM-TR-91-C-023) Avail: NTIS HC/MF A03

The effect of formulated molecular weight (FMW), extent of cure, and cumulative aging on the amount of cyclopentadiene (CPD) evolved from Polymerization of Monomeric Reactants (PMR) polyimides were investigated by pyrolysis-gas chromotography (PY-GC). The PMR polyimides are additional crosslinked resins formed from an aromatic diamine, a diester of an aromatic tetracarboxylic acid and a monoester of 5-norbornene-2, 3-dicarboxylic acid. The PY-GC results were related to the degree of crosslinking and to the thermo-oxidative stability (weight loss) of PMR polyimides. Thus, PY-GC has shown to be a valid technique for the characterization of PMR polyimide resins and composites via correlation of the CPD evolved versus the thermal history of the PMR sample. Author

N92-25391# Sandia National Labs., Albuquerque, NM.
SIMULATION OF THE DYNAMIC BEHAVIOR OF POLYMERIC GELS
W. R. Witkowski, D. J. Segalman, D. B. Adolf, and B. Hance 1992 5 p Presented at the 1st European Conference on Smart Structures and Materials, Glasgow, England, 12-14 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-008685; SAND-91-2700C; CONF-9205105-1) Avail: NTIS HC/MF A01

This paper presents a theoretical model to predict the curvature of a rectangular gel which is subjected to a pH gradient. The curvature is formulated as a function of volumetric strains. Experimental observations indicate a direct coupling between the electric field and the gel that induces an immediate volume collapse independent of pH gradients. Additional deformations occur later due to a pH gradient evolving through hydrolysis. DOE

N92-25397* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
POLYMER-COATED SURFACES TO CONTROL SURFACE ZETA POTENTIAL Patent
James M. VanAlstine, inventor (to NASA), J. Milton Harris, inventor (to NASA), Steve Shafer, inventor (to NASA), Robert S. Snyder, inventor (to NASA), and Blair J. Herren, inventor (to NASA) 1 Sep. 1987 16 p Filed 16 Dec. 1985
(NASA-Case-MFS-26050-1; US-Patent-4,690,749;
US-Patent-Appl-SN-808981; US-Patent-Class-204-299R;
US-Patent-Class-204-300EC; US-Patent-Class-428-403;
US-Patent-Class-428-405; US-Patent-Class-428-407;
Int-Patent-Class-B01D-13/02; Int-Patent-Class-C25D-13/00)
Avail: US Patent and Trademark Office

A method for eliminating or controlling electroosmosis and other zeta potential related phenomena in electrophoresis comprising conducting electrophoresis employing electrophoretic surfaces coated with covalently bound hydrophilic, neutral polymers is described. An electrophoretic chamber for eliminating or controlling electroosmosis and other zeta potential related phenomena in electrophoresis comprising electrophoretic surfaces coated with covalently bound hydrophilic, neutral polymers, is also disclosed as well as particles exhibiting controlled electrophoretic mobility. The method and electrophoretic chamber not only eliminate electroosmosis, but allow for specific control of electroosmosis. The coated electrophoretic surface is stable relative to prior art coatings and over a broad range of pH. The point of optical focus for accurate mobility measurements is increased from a narrow stationary level to the entire chamber, facilitating accurate measurements by mechanical means. The method also reduces or eliminates asymmetric fluid flows due to electroosmosis in electrophoretic chambers of square or rectangular cross section.
Official Gazette of the U.S. Patent and Trademark Office

N92-25453 National Physical Lab., Teddington (England). Div. of Materials Metrology.
THE STRUCTURE OF SILICATE MELTS
K. C. Mills Dec. 1991 81 p
(NPL-DMM(A)-43; ISSN-0143-7313; ETN-92-91379) Copyright
Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Work carried out to determine the structures of silicate melts is presented. Present knowledge of the structure of these melts is derived from analysis of physical property and spectroscopic data. It is shown that molten silicates contain various anionic units such as SiO2, Si2O5(2-), Si2O6(4-), etc. that are all based on SiOI4(4-) tetrahedra which are interconnected into a three dimensional network. Cations such as Al(3+), Fe(3+), Ti(4+), and P(5+) can also form tetrahedra MO4(n-) and fit into the SiO4(4-) network, but cations such as Na or Ca(2+) are required to maintain electrical charge balance, for example NaAlO4(4-). The effect of the various silicate anions upon the physical properties is usually expressed in terms of the overall number of bridging, nonbridging, and free oxygens which is given by the term (NBO/T) which represents the degree of depolymerization of the melt. However, the nature of the cations (for example Ca(2+) or Na (+)) also has an effect on the (NBO/T) ratio and this effect can be related to the electrical field strength (z/r squared). ESA

N92-25461# Brookhaven National Lab., Upton, NY.
BORON NITRIDE PROTECTIVE COATING OF BERYLLIUM WINDOW SURFACES
N. F. Gmuer Dec. 1991 21 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-007632; BNL-46597; CONF-9110146-12) Avail: NTIS HC/MF A03

The use of beryllium windows on white synchrotron radiation beamlines is constrained by the fact that the downstream surfaces of these windows should not be exposed to ambient atmosphere. They should, rather, be protected by a tail-piece under vacuum or containing helium atmosphere. This tailpiece is typically capped

by Kapton or aluminum foil. The reason for such an arrangement is due to the health risk associated with contaminants (BeO) which form on the exposed beryllium window surfaces and due to possible loss of integrity of the windows. Such a tail-piece may, however, add unwanted complications to the beamline in the form of vacuum pumps or helium supplies and their related monitoring systems. The Kapton windows may burn through in the case of high intensity beams and lower energy radiation may be absorbed in the case of aluminum foil windows. A more ideal situation would be to provide a coating for the exposed beryllium window surface, sealing it off from the atmosphere, thus preventing contamination and/or degradation of the window, and eliminating the need for helium or vacuum equipment. DOE

N92-25611*# Akron Univ., OH. Dept. of Polymer Science.
THE STUDY OF THE THERMAL BEHAVIOR OF A NEW SEMICRYSTALLINE POLYIMIDE Final Technical Report
Stephen Z. D. Cheng and Tammy M. Chalmers 15 May 1992 31 p
(Grant NAG3-1288)
(NASA-CR-190337; NAS 1.26:190337) Avail: NTIS HC/MF A03

Thermal properties of a new semicrystalline polyimide synthesized from 3,3',4,4' benzophenone tetracarboxylic dianhydride (BTDA) and 2,2 dimethyl 1,2-(4 aminophenoxy) propane (DMDA) were studied. Heat capacities in the solid and liquid states of BTDA-DMDA were measured. The heat capacity increase at the glass transition temperature (T sub g = 230 C) is 145 J/(C mol) for amorphous BTDA-DMDA. The equilibrium heat of fusion of the BTDA-DMDA crystals was obtained using wide angle X ray diffraction and differential scanning calorimetry measurements, and it is 75.8 kJ/mol. Based on the information of crystallinity and the heat capacity increase at T sub g, a rigid amorphous fraction is identified in semicrystalline BTDA-DMDA samples. The rigid amorphous fraction represents an interfacial region between the crystalline and amorphous states. In particular, this fraction increases with the crystallinity of the sample which should be associated with crystal sizes, and therefore, with crystal morphology. It was also found that this polymer has a high temperature crystal phase upon annealing above its original melting temperature. The thermal degradation activation energies are determined to be 154 and 150 kJ/mol in nitrogen and air, respectively. Author

N92-25640 Michigan State Univ., East Lansing.
THERMAL FATIGUE IN CERAMICS AND CERAMIC MATRIX COMPOSITES. Ph.D. Thesis
Won Jae Lee 1991 290 p
Avail: Univ. Microfilms Order No. DA9208801

Cyclic thermal shock damage by water quench in SiC whisker reinforced alumina ceramic-ceramic composites and polycrystalline alumina was monitored nondestructively via elastic modulus and internal friction measurements. A power law relationship between the saturation damage level and thermal shock difference implies a fatigue-like power law relation in stress. The crack growth rates for the unreinforced polycrystalline ceramics are far more sensitive to Delta(T) than the composite materials used in this study. Exponents in the power law fatigue relations are functions of thermal shock resistance parameters such as R(quadruple prime) and hence are likely also functions of materials parameters such as fracture toughness. The results of this study suggest the existence of threshold fracture toughness (or strength) above which thermal shock damage will not accumulate for a given Delta(T). A technique for measuring the surface heat transfer coefficient, h, is developed for quenched ceramics that combines a parameter estimation method with a fast-response capability of recently developed thin-film thermocouples. The surface heat transfer coefficient values were measured for alumina quenched into water, oil, and liquid nitrogen. Measurements of heat transfer coefficient, h, for water, silicone oil, and liquid nitrogen quenches show that h for silicon oil is an order of magnitude higher than for liquid nitrogen and an order of magnitude lower than for water. The surface tensile stress developing during quenching was calculated using temperature-dependent function of the measured surface heat transfer coefficient, the Young's modulus, the coefficient of thermal expansion, Poisson's ratio, and thermal shock severity.
Dissert. Abstr.

N92-25974# Cornell Univ., Ithaca, NY. Dept. of Materials Science and Engineering.
CERAMIC FILMS AND INTERFACES: CHEMICAL AND MECHANICAL PROPERTIES
R. Raj 1 Dec. 1991 8 p
(Contract DE-FG02-87ER-45303)
(DE92-008792; DOE/ER-45303/T2) Avail: NTIS HC/MF A02

In this progress report we begin by highlighting our work on the enhancement of interfacial cohesion in alumina by small additions of transition metals. A possible mechanism by which grain boundaries in ceramic can be strengthened is proposed towards the end of this report and is further elaborated in the continuation proposal. The results support the view that the addition of zirconia lowers the interfacial energy in alumina. The lower interface energy has the effect of (1) increasing interfacial cohesion, (2) increasing the activation energy for diffusional transport required for superplastic deformation and sintering, and (3) delaying nucleation in the crystallization of an amorphous alloy of alumina and zirconia. DOE

N92-26076# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
WELL-DEFINED REDOX-ACTIVE POLYMERS AND BLOCK COPOLYMERS PREPARED BY LIVING RING-OPENING METATHESIS POLYMERIZATION Technical Report No. 43, 1990-1991
D. Albagli, G. Bazan, M. S. Wrighton, and R. R. Schrock 4 Feb. 1992 43 p
(Contract N00014-84-K-0553)
(AD-A245795) Avail: NTIS HC/MF A03

Studies of electroactive polymers attached to the surface of electrodes have focused more on electrochemical characteristics than on polymer structure. Modification of electrodes with such polymers in order to achieve molecular electronic functions, such as pH-dependent charge trapping and chemical sensing, has been successful to some degree, but ideally one would like to be able to control the primary structure and the morphology of a polymer to a degree that would maximize the desired electrochemical properties. Such a goal becomes difficult, if not impossible, to achieve using traditional polymer synthesis techniques as the required polymers quickly become relatively exotic and complicated. The primary structure of an electroactive polymer, and ultimately its morphology (Lamellae, rods, or spheres), could be controlled if living polymerization techniques could be employed. Under such circumstances (no chain transfer or termination) the nature of the functionality at each end of the polymer, as well as the nature and length of blocks (containing a given monomer) in the polymer chain could be specified. GRA

N92-26087 Department of the Navy, Washington, DC.
LOW TEMPERATURE SYNTHESIS OF HIGH PURITY MONOCLINIC CELSIAN Patent
Inna G. Talmy, inventor (to Navy) and Deborah A. Haught, inventor (to Navy) 20 Aug. 1991 6 p Filed 13 Sep. 1990 Supersedes AD-D014715
(AD-D015186; US-Patent-5,041,400; US-Patent-Appl-SN-582269; US-Patent-Class-501-125) Avail: US Patent and Trademark Office

Ceramics based on monoclinic celsian (BaO*Al2O3*-2SiO2) can be considered for applications requiring materials with a combination of high melting point, low thermal expansion, high thermal shock resistance, high-frequency working capabilities, low and thermally stable dielectric constant and low loss tangent. For example, celsian is a promising candidate for use as thermally stable dielectric and refractory materials. Accordingly, an object of this invention is to provide a method of producing pure monoclinic celsian (BaO-*Al2O3*2SiO2) at lower temperatures and shorter heating times than conventional methods. Another object of this

invention is to provide a method of producing monoclinic celsian without the use of chemical additives which would contaminate it and adversely affect its high temperature strength. GRA

N92-26162 Department of the Navy, Washington, DC.
CONSOLIDATION OF DIAMOND PACKED POWDERS Patent
Lawrence T. Kabacoff, inventor (to Navy) and John Barkyoumb, inventor (to Navy) 14 Jan. 1992 4 p Filed 8 Jul. 1991
(AD-D015191; US-Patent-5,080,752; US-Patent-Appl-SN-726488; US-Patent-Class-156-603) Avail: US Patent and Trademark Office

A process for producing a diamond composite comprising diamond powder particles bonded together by polycrystalline diamond by (1) pressing an intimate mixture of fine opaque nondiamond carbon powder and transparent diamond powder to form a green body that is confined in either a thin walled transparent quartz vessel or a polycrystalline diamond coating; (2) using a pulse laser to quickly melt the opaque nondiamond carbon powder; and (3) allowing the carbon melt to cool and grow homoepitaxially from the surfaces of the diamond particles producing a polycrystalline diamond that bonds the diamond particles together. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-25277*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNOLOGY ISSUES ASSOCIATED WITH USING DENSIFIED HYDROGEN FOR SPACE VEHICLES
Terry L. Hardy and Margaret V. Whalen 1992 15 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-105642; E-6988; NAS 1.15:105642; AIAA-92-3079) Avail: NTIS HC/MF A03

Slush hydrogen and triple-point hydrogen offer the potential for reducing the size and weight of future space vehicles because these fluids have greater densities than normal-boiling-point liquid hydrogen. In addition, these fluids have greater heat capacities, which make them attractive fuels for such applications as the National Aerospace Plane and cryogenic depots. Some of the benefits of using slush hydrogen and triple-point hydrogen for space missions are quantified. Some of the major issues associated with using these densified cryogenic fuels for space applications are examined, and the technology efforts that have been made to address many of these issues are summarized. Author

N92-25464# Technische Univ., Delft (Netherlands). Div. of Heat Treatment Science and Technology.
EXTRUSION OF Al-Si-X ALLOYS PREPARED FROM RAPIDLY SOLIDIFIED POWDERS Ph.D. Thesis
J. Zhou 29 Oct. 1991 196 p Sponsored by Nederlandse Organisatie voor Wetenschappelijk Onderzoek, The Hague
(PB92-150168) Avail: NTIS HC/MF A09

Powder metallurgy (P/M) provides Al-Si-X alloys with new alloying and processing possibilities that are not obtainable via the conventional routes. However, many fundamental and applied problems associated with the achievement of desired properties through consolidation using hot extrusion, during which atomized powders are converted into engineering materials in one operation, are at present unsolved. The thesis, based on a selection of publications, aims at providing some of the solutions to these problems through characterizing and optimizing the extrusion process in both metallurgical and mechanical terms. GRA

N92-25957*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SLUSH HYDROGEN TRANSFER STUDIES AT THE NASA K-SITE TEST FACILITY
Terry L. Hardy and Margaret V. Whalen 1992 10 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-105596; E-6932; NAS 1.15:105596; AIAA-92-3384) Avail: NTIS HC/MF A02

An experimental study was performed as part of the National Aerospace Plane (NASP) effort to determine slush hydrogen production and transfer characteristics. Flow rate and pressure drop characteristics were determined for slush hydrogen flow through a vacuum-jacketed transfer system. These characteristics were compared to similar tests using normal boiling point and triple point hydrogen. In addition, experimental flow characteristic data was compared with predictions from the FLUSH analytical model. Slush hydrogen density loss during the transfer process was also examined. Author

N92-25992# Canada Centre for Mineral and Energy Technology, Ottawa (Ontario).
THE 1991 WINDSOR WORKSHOP ON ALTERNATIVE FUELS
1991 534 p Presented at the 1991 Windsor Workshop on Alternative Fuels, Toronto, Quebec, 24-26 Jun. 1991 Prepared in cooperation with DOE, Washington, DC
(DE92-008407; CONF-9106325) Avail: NTIS HC/MF A23

Owing to the success of last year's venture, EMR's Canada Center for Mineral and Energy Technology (CANMET), the US Department of Energy (DOE), and the Ontario Ministry of Energy teamed together again to sponsor the eighth Windsor Workshop on Alternative Transportation Fuels. As in earlier years, the 1991 workshop maintained its traditional 'shirt sleeve approach' to encourage the informal exchange of information among its participants, which include engine and vehicle manufacturers, fuel suppliers, public and private research organizations, and academic and regulatory bodies. In keeping with this theme, many of the papers presented in these proceedings are not in text form. A number of key questions and answers are appended to each paper, which should serve as a reminder of some of their more salient points. DOE

N92-25999# Lawrence Livermore National Lab., CA.
KNOCK CHARACTERISTICS OF LIQUID AND GASEOUS FUELS IN LEAN MIXTURES
P. D. Ronney, M. Shoda, S. T. Waida (Princeton Univ., NJ.), C. K. Westbrook, and W. J. Pitz 20 Jun. 1991 20 p Presented at the Society of Automotive Engineers International Fuels and Lubricants Meeting and Exposition, Toronto (Canada), 7-10 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008934; UCRL-JC-107456; CONF-911025-3) Avail: NTIS HC/MF A03

The knock characteristics of natural gas (NG), 89 octane unleaded gasoline, 2,2-dimethyl butane (22DMB), and methyl tert-butyl ether (MTBE) in stoichiometric and lean fuel-air mixtures were studied in a production 4-cylinder automotive engine. The Intake Temperature at the Knock Limit (ITKL) was found to be very different for each fuel but in every case the ITKL of lean mixtures was much higher than that of a stoichiometric mixture. Gasoline and 22DMB exhibited a much greater increase in ITKL than MTBE and NG at lean conditions. Surprisingly, for lean mixtures 22DMB exhibited values of ITKL that were much higher than MTBE and almost as high as those of NG. These results are compared with a detailed numerical model of autoignition chemistry. Good agreement between model and experiment is found for all modelled conditions. The computations show that the internal isomerization of alkyperoxy radicals which form much more readily in gasoline and 22DMB than the other fuels, accounts for the effect of equivalence ratio on the ITKL. DOE

N92-26131*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SLUSH HYDROGEN PRESSURIZED EXPULSION STUDIES AT THE NASA K-SITE FACILITY
Margaret V. Whalen and Terry L. Hardy 1992 10 p Presented at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored in part by AIAA, SAE, ASME, and ASEE
(NASA-TM-105597; E-6933; NAS 1.15:105597; AIAA-92-3385)
Avail: NTIS HC/MF A02

An experiment test series of the slush hydrogen (SLH2) project at the NASA LeRC Plum Brook K-Site Facility was completed. This testing was done as part of the characterization and technology database development on slush hydrogen required for the National Aero-Space Plane (NASP) Program. The primary objective of these experiments was to investigate tank thermodynamic parameters during the pressurized expulsion of slush hydrogen. To accomplish this, maintenance of tank pressure control was investigated during pressurized expulsion of slush hydrogen using gaseous hydrogen and gaseous helium pressurant. In addition, expulsion tests were performed using gaseous helium for initial pressurization, then gaseous hydrogen during expulsion. These tests were conducted with and without mixing of the slush hydrogen. Results from the testing included an evaluation of tank pressure control, pressurant requirements, SLH2 density change, and system mass and energy balances. Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

N92-25618*# National Aeronautics and Space Administration, Washington, DC.
MICROGRAVITY PROGRAM STRATEGIC PLAN, 1991
1991 35 p
(NASA-TM-107830; NAS 1.15:107830) Avail: NTIS HC/MF A03

The all encompassing objective of the NASA Microgravity Program is the use of space as a lab to conduct research and development. The on-orbit microgravity environment, with its substantially reduced buoyancy forces, hydrostatic pressures, and sedimentation, enables the conduction of scientific studies not possible on Earth. This environment allows processes to be isolated and controlled with an accuracy that cannot be obtained in the terrestrial environment. The Microgravity Science and Applications Div. has defined three major science categories in order to develop a program structure: fundamental science, including the study of the behavior of fluids, transport phenomena, condensed matter physics, and combustion science; materials science, including electronic and photonic materials, metals and alloys, and glasses and ceramics; and biotechnology, focusing on macromolecular crystal growth as well as cell and molecular science. Experiments in these areas seek to provide observations of complex phenomena and measurements of physical attributes with a precision that is enabled by the microgravity environment. Author

N92-26135*# Cleveland State Univ., OH. Dept. of Chemical Engineering.
MACROSEGREGATION DURING PLANE FRONT DIRECTIONAL SOLIDIFICATION OF CsI-1 WT. PERCENT TlI ALLOY Final Technical Report
I. M. S. Sidawi and S. N. Tewari 1991 28 p
(Contract NCC3-96)
(NASA-CR-190360; NAS 1.26:190360) Avail: NTIS HC/MF A03

Macrosegregation produced during vertical Bridgeman directional solidification of CsI-1 wt. pct. TlI in crucibles of varying diameter, from 0.5 to 2.0 cm, was examined. Gravity driven convection is present in the melt even in the smallest crucible diameter of 0.5 cm. Observed solutal profiles are in agreement with the analytical boundary layer model of Favier which describes macrosegregation in the presence of convection. The scintillation efficiency of CsI decreases along the specimen length as the thallium iodide content of the alloy increases. Author

N92-25832# Creare, Inc., Hanover, NH.
DESIGN METHODS, SCALING, AND MICROGRAVITY TESTING OF AN EXPERIMENTAL TWO-PHASE THERMAL SYSTEM
C. J. Crowley *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 53-60
(For primary document see N92-25828 16-18)
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N92-25833# National Aerospace Lab., Emmeloord (Netherlands). Space Div.
THERMAL GRAVITATIONAL MODELLING AND SCALING OF TWO-PHASE HEAT TRANSPORT SYSTEMS FOR SPACE: AN ASSESSMENT AND A COMPARISON OF PREDICTIONS AND EXPERIMENTAL RESULTS
A. A. M. Delil *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 61-67
(For primary document see N92-25828 16-18)
(Contract NIVR-2404-N)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-25542# Air Force Systems Command, Bolling AFB, Washington, DC.
METRICS HANDBOOK (AIR FORCE SYSTEMS COMMAND)
Aug. 1991 82 p
(PB92-162643) Avail: NTIS HC/MF A05

The handbook is designed to help one develop and use good metrics. It is intended to provide sufficient information to begin developing metrics for objectives, processes, and tasks, and to steer one toward appropriate actions based on the data one collects. It should be viewed as a road map to assist one in arriving at meaningful metrics and to assist in continuous process improvement. Author

N92-25570 Florida Univ., Gainesville.
FORMAL AND HEURISTIC SYSTEM DECOMPOSITION METHODS IN MULTIDISCIPLINARY SYNTHESIS Ph.D. Thesis
Christina Lynne Bloebaum 1991 167 p
Avail: Univ. Microfilms Order No. DA9208985

The multidisciplinary interactions which exist in large scale engineering design problems provide a unique set of difficulties. These difficulties are associated primarily with unwieldy numbers of design variables and constraints, and with the interdependencies of the discipline analysis modules. Such obstacles require design techniques which account for the inherent disciplinary couplings in the analyses and optimizations. The objective of this work is to develop an efficient holistic design synthesis methodology that takes advantage of the synergistic nature of integrated design. Although the design process encompasses several stages in which optimization methods could be applied, the present study addresses the applications of optimization in the preliminary design stage, in which the most capability for positive change exists. A primary concern in this stage involves implementation of an accurate and efficient mathematical representation of large engineering systems. Without such a representation, meaningful design synthesis is impossible. Multilevel decomposition methods provide a systematic approach for decoupling the large complex systems found in multidisciplinary design problems into smaller, more manageable subsystems. These methods account for the couplings between the intrinsically linked disciplinary analysis modules on the basis of a linear sensitivity analysis. In a majority of such efforts, the

decomposition is governed either by an obvious hierarchy in the system or on the basis of discipline. Dissert. Abstr.

N92-25651# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
INDUSTRIAL HEAT EXCHANGERS
1991 655 p Lecture series held in Rhode-Saint-Genese, Belgium, 27-31 May 1991
(VKI-LS-1991-04; ISSN-0377-8312; ETN-92-91357) Copyright Avail: NTIS HC/MF A99

The objective of this lecture series was to provide an up to date account of problems associated with the design and testing of heat exchangers. Potential uses of heat exchangers in the process industry were exemplified. Future trends were stated. Basic techniques were discussed for single and two phase situations. Their application to actual heat exchangers were described. Performance evaluation criteria and practical issues such as startup problems of boiling behavior and fouling were reviewed. Sessions on heat exchange coefficient and different types of heat exchangers are given. For individual titles, see N92-25652 through N92-25667.

N92-25652# General Motors Corp., Lockport, NY. Harrison Div.
INDUSTRIAL HEAT EXCHANGERS: TYPES AND FUNCTIONS **c34**
R. K. Shah *In* VKI, Industrial Heat Exchangers 1991 63 p (For primary document see N92-25651 16-31)
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Types and functions of industrial heat exchangers are detailed with classifications according to the transfer processes, number of fluids, degree of surface compactness, construction features, flow arrangements, and heat transfer mechanisms. The terminology associated with a variety of these exchangers is introduced and practical applications are outlined. ESA

N92-25653# General Motors Corp., Lockport, NY. Harrison Div.
MULTIDISCIPLINARY APPROACH TO HEAT EXCHANGER DESIGN
R. K. Shah *In* VKI, Industrial Heat Exchangers 1991 11 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

An overall methodology that described various quantitative and qualitative design aspects, and their interaction and interdependence, to arrive at an optimum heat exchanger design, is presented. Major design considerations include process specification, thermal and hydraulic design, mechanical design (including operation and maintenance considerations), manufacturing considerations, and cost. Most of these considerations are dependent on each other and should be considered simultaneously to arrive iteratively at the optimum exchanger design. These are discussed in order to demonstrate the multidisciplinary approach of heat exchanger design in order to obtain an overall optimum solution. ESA

N92-25654# General Motors Corp., Lockport, NY.
PLATE HEAT EXCHANGER DESIGN THEORY
R. K. Shah and A. S. Wanniarachchi (Heat Transfer Research, Inc., College Station, TX.) *In* VKI, Industrial Heat Exchangers 1991 37 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

Plate heat exchangers are commonly used in hygienic applications as well as in chemical processing and other industrial applications. Pertinent information on plate exchangers from a designer's point of view is summarized to provide a basic insight into performance behavior of chevron plates. Basic design methods are presented and a method of coupling between heat transfer and pressure drop is introduced. A step by step design procedure for rating and sizing problems is outlined. ESA

N92-25655# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
EMPIRICAL DETERMINATION OF HEAT TRANSFER COEFFICIENTS **c77**
Martin Fiebig *In* VKI, Industrial Heat Exchangers 1991 38 p (For primary document see N92-25651 16-31)
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The usefulness and problems associated with the heat transfer coefficient are discussed. It is possible to determine the local heat transfer coefficient by optical methods. Two methods are presented: liquid crystal thermography and ammonium absorption with surface reaction. ESA

N92-25656# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
NUMERICAL METHODS FOR CONVECTIVE HEAT TRANSFER **c77**
Martin Fiebig *In* VKI, Industrial Heat Exchangers 1991 64 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

Single phase forced convection of constant properties fluids in three dimensional passages encountered in heat exchangers is addressed. Several general techniques are used to solve the basic thermo-hydraulic conservation equations: finite element methods, spectral element methods, and finite volume/finite difference methods. A finite volume/finite difference method for single phase forced convection of a constant properties fluid is outlined. To give a feeling for the complexity of the problem, the basic equations are introduced. Laminar and turbulent convection are considered with emphasis on three dimensional examples. ESA

N92-25657# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
HEAT TRANSFER ENHANCEMENT FOR SINGLE PHASE FORCED CONVECTION **c34**
Martin Fiebig *In* VKI, Industrial Heat Exchangers 1991 71 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

Goals for heat exchanger design are outlined and performance evaluation criteria are discussed. The flow geometries in heat exchangers, which can be classified as channel or tube flow, are described. The use of finned plates or tubes for channel flow and internally finned tubes or wire coil and twisted tape inserts for tube flow are considered. ESA

N92-25658# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
NUMERICAL METHODS FOR THERMAL CALCULATIONS OF HEAT EXCHANGERS **c77**
P. Mercier *In* VKI, Industrial Heat Exchangers 1991 39 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

Global and analytical methods for the sizing of heat exchangers are described. Two thermal sizing methods used on a number of different types of heat exchangers are presented and illustrated. A hydraulic network method applied to the sizing of plate heat exchangers is presented. Multidimensional thermohydraulic calculation methods are discussed. They present a particular interest when flow patterns inside the exchanger are unknown. Software designed for these methods is presented, as well as a few examples of results obtained. ESA

N92-25659# Rensselaer Polytechnic Inst., Troy, NY.
ENHANCED HEAT TRANSFER TECHNIQUES FOR INDUSTRIAL HEAT EXCHANGERS
A. E. Bergles *In* VKI, Industrial Heat Exchangers 1991 31 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

An introductory lecture on the enhancement of convective heat transfer which provides background for the many applications of this 'second generation heat transfer technology' is presented. The many available enhancement techniques are described, and some representative performance data and correlations are given for the popular passive techniques. The discussion is organized according to the modes of heat transfer ranging from single phase forced convection to forced convection condensation. ESA

N92-25660# Indiana Univ.-Purdue Univ., Fort Wayne. Dept. of Engineering.
BOILING AND CONDENSATION IN MICROFIN TUBES c34
Lynn M. Schlager *In* VKI, Industrial Heat Exchangers 1991 28 p (For primary document see N92-25651 16-31)
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A general overview of microfin tubes and their applications is presented. Manufacturing processes, commercial availability, experimental heat transfer, and pressure drop data for various refrigerants (including alternative refrigerants and refrigerant-oil mixtures), physical mechanisms of enhancement, and the incorporation of microfin tubes in common heat exchanger configurations are discussed. Microfin tubes, also known by various trade names, are characterized by numerous small fins which typically spiral down the inside wall of tubes at angles ranging from 10 to 30 degrees. The number of fins ranges from 48 to 70 with typical fin heights of 0.12 to 0.30 mm (fin height generally less than 3 percent of the inside diameter of the tube). Fin shapes may vary and the inside surface area of microfin tubes is 10 to 70 percent greater than the area of equivalent smooth tubes. Heat transfer can be enhanced by up to a factor of three with microfin tubes. ESA

N92-25661# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
ADVANCES IN SHELL SIDE CONDENSATION FOR REFRIGERANTS
Ralph L. Webb *In* VKI, Industrial Heat Exchangers 1991 27 p (For primary document see N92-25651 16-31)
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The design of shell and tube condensers used in air conditioning and refrigeration applications is discussed. The geometry of interest involves condensation on the shell side of a horizontal tube bundle. Enhanced heat transfer geometries are typically used for condensation on the shell side. The heat transfer is removed by water on the tube side, which typically have tube side enhancement. Single tube and row effect condensation data are presented. Thermal design methods for sizing of the condenser are outlined. ESA

N92-25662# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
ADVANCES IN SHELL SIDE BOILING OF REFRIGERANTS
Ralph L. Webb *In* VKI, Industrial Heat Exchangers 1991 31 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

The design of shell and tube evaporators used in air conditioning and refrigeration applications is discussed. The heat exchanger geometry of interest involves evaporation or condensation on the shell side of a horizontal tube bundle. Enhanced heat transfer geometries are typically used for shell side evaporation and for forced convection to water on the tube side. Refrigerant boiling data and forced convection refrigerant boiling correlations are described. The refrigerants of interest include R-11, 12, 22, 123, and 134a. Thermal design methods for sizing of the evaporator and condenser are outlined. A computer model for prediction of the evaporator performance is described. ESA

N92-25663# Mons Univ. (Belgium). Thermal Engineering.
HEAT EXCHANGERS AND RECUPERATORS FOR HIGH TEMPERATURE WASTE GASES
H. Meunier *In* VKI, Industrial Heat Exchangers 1991 76 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

General considerations on high temperature waste heat recovery are presented. Internal heat recovery through combustion air preheating and external heat recovery are addressed. Heat transfer and pressure drop in heat exchanger design are discussed. ESA

N92-25664# Mons Univ. (Belgium). Faculte Polytechnique.
CERAMIC HEAT EXCHANGERS
J. Henriette *In* VKI, Industrial Heat Exchangers 1991 34 p (For primary document see N92-25651 16-31)
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The use of ceramic materials in heat exchanger manufacturing is discussed. Oxide and non-oxide ceramics are described. Materials processing, forming of typical components for heat exchangers, manufacturing cost, strength evaluation, joining, and design examples are discussed. ESA

N92-25665# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
DIRECT-CONTACT HEAT EXCHANGER
A. Bricard *In* VKI, Industrial Heat Exchangers 1991 37 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

The working principle of direct contact heat exchanger, where heat transfer takes place between two immiscible fluids coming into direct contact, is described. Typical direct contact devices are outlined. A better understanding of the principles involved and the development of computational models for multiphase subsytems are concluded as stimulus for direct contact heat and mass transfer applications. ESA

N92-25666# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
THE HEAT PIPE HEAT EXCHANGERS: DESIGN, TECHNOLOGY AND APPLICATIONS
S. Chadourne *In* VKI, Industrial Heat Exchangers 1991 16 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

The Heat Pipe Heat Exchanger (HPHE) is a relatively new and very attractice heat exchanger type. For a good understanding of this very special heat exchanger, a minimum knowledge of the heat pipes is required. The heat pipe and thermosyphon basic theory (including the calculation of the thermal limits) is summarized. Some information concerning the heat pipe technological aspects is given. A model of the HPHE is presented, and a design methodology using this model is described. The most interesting areas of applications of the HPHE are indicated and some examples are presented. ESA

N92-25667# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL METHODS TO DETERMINE HEAT EXCHANGER PERFORMANCES
C. Marvillet and R. Vidil *In* VKI, Industrial Heat Exchangers 1991 35 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

A heat exchanger test platform and experiments carried out thereon are described. The following studies are summarized: determination of the performances of a welded plate evaporator for a refrigeration unit; determination of the performance of a compact heat exchanger for gas turbine heat recovery; and determination of the performance of a fin and tube heat exchanger on diesel engine exhaust gases. ESA

N92-25955*# Ball Corp., Boulder, CO. Electro-Optics/Cryogenics Div.
TDS AND BMT FOR CASES ADF (ADF RAMS), ACCEPTANCE TEST Final Report, 2 Jan. 1991 - 21 Feb. 1992
Hugh W. Davis 13 Feb. 1992 107 p
(Contract NAS8-38581; Proj. 3659)
(NASA-CR-184323; NAS 1.26:184323) Avail: NTIS HC/MF A06

The Controls, Astrophysics, and Structures Experiment (CASES) is a proposed experiment to collect x ray images of the galactic center and solar disk with unprecedented resolution. This requires precision pointing and suppression of vibrations in the long, flexible structure that comprises the 32-m x ray telescope optical bench. Two separate electro-optical sensors systems are provided for the ground test facility (GTF). The Boom Motion Tracker (BMT) measures eigenvector data for post-mission use in system identification. The Tip Displacement Sensor (TDS) measures boom

tip position and is used as feedback for the closed-loop control system that stabilizes the boom. The deployment and testing of the BMT and TDS systems is summarized. Author

N92-25977# Allied-Signal Aerospace Co., Kansas City, MO.
CONVERSION FROM SOLVENT RINSABLE FLUXES TO AQUEOUS RINSABLE FLUXES FOR HOT OIL SOLDER LEVELING
Mar. 1992 5 p
(Contract DE-AC04-76DP-00613)
(DE92-009552; KCP-613-4548) Avail: NTIS HC/MF A01

A water rinsable flux was evaluated for hot oil solder leveling of printed wiring boards. The previously used rosin-activated flux required a solvent containing a chlorinated hydrocarbon for removing the flux residues after soldering. The water rinsable flux requires hot water or a solution of hot detergent for removing flux residues after smoldering. The water rinsable flux produced an acceptable soldered surface. Flux residues were removed by either hot water (120 F) or a solution of hot detergent (120 F). DOE

N92-25850# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.
AN OVERVIEW OF ESA CRYOCOOLER ACTIVITIES
C. I. Jewell *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 195-199 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25851# British Aerospace Public Ltd. Co., Bristol (England).
PRE-QUALIFICATION LEVEL TESTING OF AN 80 K STIRLING CYCLE COOLER
S. R. Scull and C. I. Jewell (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 201-207 (For primary document see N92-25828 16-18)
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N92-25853# Lucas Aerospace Ltd., Birmingham (England). Engine Systems Div.
THE DEVELOPMENT OF A RANGE OF LOW VIBRATION MECHANICAL CRYOCOOLERS FOR SPACE APPLICATION
Barry N. Hocking *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 217-221 (For primary document see N92-25828 16-18)
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N92-25854# MATRA Marconi Space, Toulouse (France).
DESIGN OF A FREEZER SYSTEM FOR COLUMBUS
P. Vidal, A. Ravex, and J. C. Villard (L'Air Liquide, Sassenage, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 223-226 (For primary document see N92-25828 16-18)
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N92-25875# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
DEVELOPMENT OF CRYOCOOLERS FOR SPACE APPLICATIONS USING HYDRODYNAMIC GAS BEARINGS
G. Claudet, L. Duband, A. Ravex, and P. Rolland *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 393-396 Sponsored by CNES and DGA (For primary document see N92-25828 16-18)
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N92-25876# Rutherford Appleton Lab., Chilton (England).
A CLOSED CYCLE 4 K MECHANICAL COOLER FOR SPACE APPLICATIONS
T. W. Bradshaw and A. H. Orlowska *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 397-401 (For primary document see N92-25828 16-18)
(Contracts ESA-6342/85/ML/PB(SC); ESA-7198/87/NL/MA(SC))
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N92-25877# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Heat Rejection Section.
A NEW He-3 REFRIGERATOR FOR SPACE APPLICATIONS
C. I. Jewell, G. DallOglio, W. Fischer, L. Piccirillo, and L. Pizzo (Rome Univ., Italy) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 403-405 (For primary document see N92-25828 16-18)
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N92-25878# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
A MINIATURE ADSORPTION He-3 REFRIGERATOR
L. Duband, A. Lange (California Univ., Berkeley.), and A. Ravex *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 407-409 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25879# British Aerospace Public Ltd. Co., Bristol (England).
DEVELOPMENT AND PRE-QUALIFICATION TESTING OF A 20 K SPACE COOLER
B. G. Jones, T. W. Bradshaw, A. H. Orlowska, and C. I. Jewell (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 411-416 (For primary document see N92-25828 16-18)
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32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-25157# Oak Ridge National Lab., TN.
MHD-EMP AND ELECTRIC POWER SYSTEMS
P. R. Barnes, D. T. Rizy, and Frederick M. Tesche (Tesche, Frederick M., Dallas, TX) 1992 6 p Presented at the 1992 Hardened Electronics and Radiation Technology (HEART) Conference, Albuquerque, NM, 24-28 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-008899; CONF-920223-5) Avail: NTIS HC/MF A02

A solar-induced geomagnetic disturbance (GMD) by its nature occurs globally and almost simultaneously. Severe geomagnetic storms have caused a range of equipment and operating problems for electric power systems; the most noteably problems according in March 1989. The vulnerability of electric power systems to such events has apparently increased during the last 10 to 20 years as power system systems have become more interconnected and as transmission lines have increased in length, and because power systems are now operated closer to their limits than in the past.

In this paper, the experience of electric utilities during geomagnetic storms is examined and analyzed. Measured data, effects on power system components, and power system impacts are considered. It is found that electric power systems are susceptible to geomagnetically-induced earth-surface potential gradients as small as a few (2 to 3) volts per kilometer corresponding to a storm of K-6 intensity over an area of high earth resistivity. The causes and effects of GMDs are reasonably well understood, but additional research is needed to develop a better understanding of solar-induced GMDs and the response of power systems to these types of storms. A better understanding of GMDs and the power systems response to GMDs is needed so that mitigation measures can be implemented which will make power systems less susceptible to severe geomagnetic disturbances. DOE

N92-25260# Lawrence Livermore National Lab., CA.
INVESTIGATION OF GIGAWATT MILLIMETER WAVE SOURCE APPLICATIONS
J. A. Bruder and M. L. Belcher Sep. 1991 69 p Prepared in cooperation with Georgia Inst. of Tech., Atlanta, GA
(Contract W-7405-eng-48)
(DE92-009528; UCRL-CR-109561) Avail: NTIS HC/MF A04

The Georgia Tech Research Institute (GTRI) investigated potential applications of millimeter wave (MMW) sources with peak powers on the order of a gigawatt. This power level is representative of MMW devices such as the free electron laser (FEL) and the cyclotron auto-resonance maser (CARM) that are under development at the Lawrence Livermore National Laboratory (LLNL). In addition to determining the technical requirements for these applications, the investigation considered potential users and how a high power MMW system would expand their current capabilities. Two of the more promising applications were examined in detail to include trade-off evaluations system parameters. The trade-off evaluations included overall system configuration, frequency and coherence, component availability, and performance estimates. Brainstorming sessions were held to try and uncover additional applications for a gigawatt MMW source. In setting up guidelines for the session, the need to attempt to predict applications for the years 2000 to 2030 was stressed. Also, possible non-DoD applications needed to be considered. While some of these applications could not in themselves justify the costs involved in the development of the radar system, they could be considered potential secondary applications of the system. As a result of the sessions, a number of interesting potential applications evolved including: space object identification; low angle tracking; illuminator for space-based radar; radio astronomy; space vehicle navigation; space debris location; atmospheric research; wind shear detection; electronic countermeasures; low observable detection; and long range detection via ducting. DOE

N92-25378 Physics and Electronics Lab. TNO, The Hague (Netherlands).
SET-UP AND ALIGNMENT ASPECTS OF A CO2-LASER RADAR FOR APPLICATIONS IN THE FIELD Final Report
H. Hebers Jun. 1991 29 p
(Contract A90KL621)
(FEL-91-A162; TD91-2229; ETN-92-91214; AD-A245623)
Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

The setup of a multifunctional CW CO2 (Continuous Wave carbon dioxide) laser radar system is described. Special attention is given to some recent modifications. They consist mainly of the addition of an Acousto-optic Modulator (AOM) in the local oscillator beam of the heterodyne detection system, and of the renewal of the HgCdTe detector. The added AOM shifts the frequency, at which heterodyne detection is performed, from the previous 100 to 140 MHz now. This implied that the processing electronics of the set up also had to be adapted. A step by step procedure for the optical alignment of the system is presented. ESA

N92-25400 Academy of Sciences of the Ukrainian SSR, Kiev. Inst. of Physics.
POWER CHARACTERISTICS OF A HIGH FREQUENCY GENERATOR IN LOCAL RESPONSE MEDIA [ENERGETICHESKIE KHARAKTERISTIKI VCHVS-GENERATORA V SREDE S LOKAL'NYM OTKLIKOM]
S. G. Odulov, S. S. Sliusarenko, M. S. Soskin, and A. I. Khizhniak 1989 33 p In RUSSIAN
Copyright Avail: Issuing Activity

This work presents the results of an analysis of the power characteristics of a High Frequency Generator (VChVS) in a local response medium as approximated by horizontal beam pumps. It is shown that the efficiency of the oscillation carries a non-monotonal character during a change in constant binding. An analysis is conducted of the characteristics of the double-mirrored and hybrid generator. The results of these experiments as they are implemented on various generators are presented. Author

N92-25425 Physics and Electronics Lab. TNO, The Hague (Netherlands).
PATTERN SYNTHESIS FOR UNEQUALLY-SPACED ARRAY ANTENNAS WITH NON-IDENTICAL ELEMENTS Final Report [PATROONSYNTHESE VOOR EEN ARRAY ANTENNE MET NIET-IDENTIEKE WILLEKEURIG GEPLAATSTE ELEMENTEN]
H. J. Stam Nov. 1991 41 p
(Contract A91KM636)
(FEL-91-A305; TD91-3694; ETN-92-91218) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

A novel method of array antenna pattern synthesis based on an optimization technique is presented. The complex excitation values of the current distribution of the array elements are taken as parameters. The radiated far field pattern is matched to one that is prescribed by minimizing a global mean square error. The method is suitable for general arrays like linear, planar, and conformal ones, and does not require the factorization into an element factor and an array factor. In contrast with Fourier like methods, the array elements may be arbitrarily placed. Although the theory is developed for arrays of identical elements, it applies to the case of arrays containing nonidentical elements as well. Numerical results for unequally spaced planar arrays of short electric dipoles are presented. ESA

N92-25427 Physics and Electronics Lab. TNO, The Hague (Netherlands).
RADIO CHANNEL MEASUREMENTS USING A BROADBAND PSEUDO-NOISE SIGNAL (MEASUREMENT SET-UP AND PROCESSING OF THE RESULTS) Final Report [RADIO KANAALMETINGEN DOOR MIDDEL VAN EEN BREEDBANDIG PSEUDO-NOISE SIGNAAL (MEETOPSTELLING EN VERWERKING VAN DE MEETRESULTATEN)]
J. A. M. Vriens and G. J. M. Janssen Jun. 1991 101 p
(FEL-91-B112; TD91-2012; ETN-92-91220; AD-A245601)
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In a multipath communications environment, which is often found in urban areas, transmission of information is difficult due to self interference. This self interference may result in signal suppression and intersymbol interference. Knowledge of the parameters that characterize the radio channel, can be used to feed an adaptive equalizer or frequency management system, in order to minimize these disturbing effects. A measurement system, to measure the characteristics of radio paths in a multipath channel, is described and measurement results are given. The measurement system uses pseudonoise spread spectrum modulation and operates in the VHF band (30 to 70 MHz). A carrier, BPSK (Bi-Phase Shift Keying) modulated with the pseudonoise signal at a rate of 1 Mchip/s, is used to sound the radio channel. The characteristics of the different radio paths, relative amplitude, RF phase, and delay time are calculated from the coherently received signal. The accuracy of the measurement system is 2 dB for the amplitude, 5 degrees for the RF phase, and 20 ns for the delay time. ESA

N92-25432*# Mendez R and D Associates, El Segundo, CA.
OPTICAL MULTIPLE ACCESS TECHNIQUES FOR ON-BOARD ROUTING Final Report
Antonio J. Mendez, Eugene Park, and Robert M. Gagliardi (University of Southern California, Los Angeles.) Mar. 1992 59 p
(Contract NAS3-25925)
(NASA-CR-187221; NAS 1.26:187221) Avail: NTIS HC/MF A04

The purpose of this research contract was to design and analyze an optical multiple access system, based on Code Division Multiple Access (CDMA) techniques, for on board routing applications on a future communication satellite. The optical multiple access system was to effect the functions of a circuit switch under the control of an autonomous network controller and to serve eight (8) concurrent users at a point to point (port to port) data rate of 180 Mb/s. (At the start of this program, the bit error rate requirement (BER) was undefined, so it was treated as a design variable during the contract effort.) CDMA was selected over other multiple access techniques because it lends itself to bursty, asynchronous, concurrent communication and potentially can be implemented with off the shelf, reliable optical transceivers compatible with long term unattended operations. Temporal, temporal/spatial hybrids and single pulse per row (SPR, sometimes termed 'sonar matrices') matrix types of CDMA designs were considered. The design, analysis, and trade offs required by the statement of work selected a temporal/spatial CDMA scheme which has SPR properties as the preferred solution. This selected design can be implemented for feasibility demonstration with off the shelf components (which are identified in the bill of materials of the contract Final Report). The photonic network architecture of the selected design is based on M(8,4,4) matrix codes. The network requires eight multimode laser transmitters with laser pulses of 0.93 ns operating at 180 Mb/s and 9-13 dBm peak power, and 8 PIN diode receivers with sensitivity of -27 dBm for the 0.93 ns pulses. The wavelength is not critical, but 830 nm technology readily meets the requirements. The passive optical components of the photonic network are all multimode and off the shelf. Bit error rate (BER) computations, based on both electronic noise and intercode crosstalk, predict a raw BER of (10 exp -3) when all eight users are communicating concurrently. If better BER performance is required, then error correction codes (ECC) using near term electronic technology can be used. For example, the M(8,4,4) optical code together with Reed-Solomon (54,38,8) encoding provides a BER of better than (10 exp -11). The optical transceiver must then operate at 256 Mb/s with pulses of 0.65 ns because the 'bits' are now channel symbols. Author

N92-25455*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DIRECT SIMULATION MONTE CARLO WITH IONIZATION AND RADIATION Ph.D. Thesis, North Carolina State Univ.
Ann B. Carlson 1990 82 p Original contains color illustrations
(NASA-TM-105495; NAS 1.15:105495) Avail: NTIS HC/MF A05; 1 functional color page

Improvements in the modeling of radiation in low density shock waves with Direct Simulation Monte Carlo (DSMC) are the subject of this study. The physical processes which determine the amount of radiation in a shock wave were investigated and the way in which they were modeled with DSMC was evaluated. Three physical processes were identified for which an improvement in the modeling technique could result in improved radiation predictions. New physical modeling schemes are introduced in this report for the three processes. First a method for determining the electric field and its effect on the flow is introduced. Second, a two step reaction process for electron impact ionization reactions is evaluated. Finally, a new scheme to determine the relaxation collision numbers for excitation of electronic states is proposed. Each new scheme attempts to move the DSMC method toward more accurate physics or more reliance on experimental data. The new schemes are all compared to the current modeling techniques and the differences in the results are evaluated. In all cases the results agree with the available data as well as, or better than the results from earlier schemes. Author

N92-25469# Los Alamos National Lab., NM.
CONSTRAINED SIGNAL RECONSTRUCTION FROM WAVELET TRANSFORM COEFFICIENTS
C. M. Brislawn 1991 5 p Presented at the 1992 IEEE International Conference on Acoustics, Speech and Signal Processing, San Francisco, CA, 23-26 Mar. 1992
(Contract W-7405-eng-36)
(DE92-007423; LA-UR-92-45; CONF-920354-4) Avail: NTIS HC/MF A01

A new method is introduced for reconstructing a signal from an incomplete sampling of its Discrete Wavelet Transform (DWT). The algorithm yields a minimum-norm estimate satisfying a priori upper and lower bounds on the signal. The method is based on a finite-dimensional representation theory for minimum-norm estimates of bounded signals developed by R. E. Cole. Cole's work has its origins in earlier techniques of maximum-entropy spectral estimation due to Lang and McClellan, which were adapted by Steinhardt, Goodrich and Roberts for minimum-norm spectral estimation. Cole's extension of their work provides a representation for minimum-norm estimates of a class of generalized transforms in terms of general correlation data (not just DFT's of autocorrelation lags, as in spectral estimation). One virtue of this great generality is that it includes the inverse DWT. DOE

N92-25478# Sandia National Labs., Albuquerque, NM.
QUICKSILVER: A 3D, TIME-DOMAIN, FINITE-DIFFERENCE CODE FOR THE ELECTROMAGNETIC SIMULATION OF COMPLEX STRUCTURES
D. B. Seidel, M. L. Kiefer, R. S. Coats, T. D. Pointon, and J. P. Quintenz 1992 4 p Presented at the Topical Meeting on Electrical Performance of Electronic Packaging, Tucson, AZ, 22-24 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-003147; SAND-92-0062C; CONF-920495-1) Avail: NTIS HC/MF A01

The QUICKSILVER suite of codes has been developed at Sandia National Laboratories for performing simulations in three dimensions using time-domain, finite-difference, electromagnetic techniques. Simulations can be performed with or without charged particles; when charged particles are included, particle-in-cell (PIC) techniques are used. In addition to the QUICKSILVER simulation tool, the suite includes a preprocessor and several postprocessors to provide the user with an efficient and easy-to-use method for problem specification and setup as well as subsequent analysis of simulation data. The entire suite may be licensed for commercial or government use. QUICKSILVER was designed as a tool for simulating the physics of high-current pulsed power and microwave devices, such as electron and ion diodes, magnetically insulated transmission lines, magnetron tubes, etc. Although all these devices require charged particles, there are many other pulsed power applications, such as pulse-forming lines and switches, that do not involve particle simulation. Consequently, the code has been designed to perform efficiently on fields-only simulations. DOE

N92-25515# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EXPERIMENTAL DEVELOPMENT AND THEORETICAL STUDIES OF RADIO-FREQUENCY ABSORBERS [REALIZACAO EXPERIMENTAL E ESTUDOS TEORICOS DE ABSORVEDORES DE RADIO FREQUENCIA]
J. L. L. M. Massa Apr. 1991 45 p In ENGLISH and PORTUGUESE
(INPE-5249-RPQ/560) Avail: NTIS HC/MF A03

A mathematical model based on the equivalence with a sequence of lossy transmission lines has been developed and applied, by numerical calculus, to the study of radio-frequency absorbers of piramidal shape, made of polyurethane foam impregnated with finely powered carbon black. The model has been used to find the expected performance of absorbers with different electrical conductivities in the microwave range of

frequencies. The results agree with the measurements of reflectivity which have been previously obtained, by the arch method, during the phase of experimental development of the absorbers, when the carbon black concentration was progressively changed.
Author

N92-25516 British Broadcasting Corp., Kingswood (England). Engineering Div.
DEVELOPMENTS IN MULTICHANNEL SOUND FOR HDTV
D. J. Meares 1991 16 p
(BBC-RD-1991/13) Copyright Avail: Issuing Activity

New sound systems are being developed to accompany High Definition Television (HDTV), which will generate better listening experiences for the audience. Outlined here are some of the intended improvements. By way of example, some of the production problems that will have to be overcome before the proposals can be implemented are illustrated. The domestic impact of the system is covered.
Author

N92-25580 California Univ., San Diego.
STATISTICS FOR WAVES THROUGH RANDOM MEDIA Ph.D. Thesis
Guang-Yu Wang 1991 161 p
Avail: Univ. Microfilms Order No. DA9202474

Many statistical aspects of the propagation of waves in random media are addressed. The main focus is on the strong forward scattering cases where the root-mean-square (rms) multiple scattering angle is small, yet the cumulative effects on intensity fluctuations are large. Also, both the propagation distance and the typical medium correlation length are much larger than the wave length. Under such conditions, the entire problem is formulated in terms of path integral which is a powerful tool for both analytic and numerical purposes. There are four main parts in this dissertation. The first part includes a systematic generalization of the existing first-order asymptotic theory. In the second part, a new perturbation scheme is developed for media with power-law spectrum. The third part establishes a more general formalism for multi-point statistics. The final part studies the analytical method of computing the frequency correlations for waves in a power-law medium. A perturbation scheme developed in field theory turns out to fit into this calculation very well.
Dissert. Abstr.

N92-25638 Nebraska Univ., Lincoln.
FULL WAVE MULTIPLE SCATTERING AND DEPOLARIZATION OF ELECTROMAGNETIC FIELDS FROM ROUGH SURFACES Ph.D. Thesis
Magda Osman El-Shenawee 1991 214 p
Avail: Univ. Microfilms Order No. DA9208105

Using the full wave approach, the single and the double scattered electromagnetic fields from deterministic one dimensionally rough surfaces are computed. Full wave expressions for the single and the double scattered far fields are given in terms of multidimensional integrals. These integrals are evaluated using a supercomputer. Applying the steepest descent approximation to the double scattered fields expression, the dimension of the integrals are reduced from four to two in the case of one dimensionally rough surfaces. It is shown that double scatter in the backward direction is significant only for near normal incidence when the rough surface is highly conducting and its mean square slope is very large. Even for one dimensionally rough surfaces, depolarization occurs when the reference plane of incidence is not parallel to the local planes of incidence and scatter. A geometrical optics approximation is used to interpret the results of the doubly scattered fields for normal incidence near backscatter. The physical interpretation of the results could shed light on the observed fluctuations in the enhanced backscatter phenomenon as the angle of incidence increases from near normal to grazing angles. For surfaces with large mean square slopes, it is found that the double scattered fields are large in the near specular direction. The results show that multiple scattering strongly depends upon the slope of the rough surface, the angle of incidence, and the conductivity of the rough surface. The analysis is extended to the two dimensional deterministic rough surfaces. Full wave expression for double scatter from the two dimensional surfaces is given in terms of four dimensional integrals.
Dissert. Abstr.

N92-25668# European Space Agency, Paris (France).
RADARS AND LIDARS IN EARTH AND PLANETARY SCIENCES
T.-Duc Guyenne, ed. and James J. Hunt, ed. Dec. 1991 139 p Symposium held in Cannes, France, 2-4 Sep. 1991; sponsored by NASA, AAAF, Italian Space Agency, and CNES
(ESA-SP-328; ISBN-92-9092-154-4; ISBN-0379-6566; ETN-92-91382) Copyright Avail: NTIS HC/MF A07

Radar and lidar applications and techniques in Earth and planetary sciences are discussed. Ground based and bistatic observations of near Earth asteroids and space debris are discussed. Aspects of spaceborne laser use in the Magellan mission to Venus are described. Subsurface radar and synthetic aperture radar to be used on the mission to Mars are discussed. The Cassini radar, the radars aboard ERS-1, and the Canadian Radarsat program are described. Research and development on lidar systems and solid state lasers are discussed. For individual titles, see N92-25669 through N92-25691.

N92-25669*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADAR RECONNAISSANCE OF NEAR-EARTH ASTEROIDS **c89**
S. J. Ostro *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 9-13 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

During the past decade, echoes from 29 near Earth asteroids have provided new information about these objects' physical and dynamical properties. In the investigation of a near Earth asteroid, the strategy is to detect the echo, refine the delay Doppler ephemeris, and then determine the dual polarization delay Doppler signature at the finest time frequency resolution possible, as a function of the target's rotation phase and sky position. In principle, with instrumentation expected to be available by the mid 1990's such an experiment should be able to yield a physical characterization of an asteroid that is as informative as Mariner 13's images of Phobos and Deimos. The near Earth asteroid population probably contains many tens of thousands of radar detectable objects, most of which can be discovered optically within a few decades. Ways in which these techniques could be used in elucidating the threat of asteroid impact are discussed.
ESA

N92-25670*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OBSERVATIONS OF SPACE DEBRIS AT GOLDSTONE (CALIFORNIA) **c89**
R. M. Goldstein and L. W. Randolph *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 15-18 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

The use of planetary radar to monitor small particles of orbital debris is reported. The radar can detect objects as small as 1.8 mm in diameter at an altitude of 600 km. The results of the first set of observations shows a flux at 600 km of 6.4 objects per square km per day of 1.8 mm in size or larger. Forty of the observed particles appear to be concentrated in one or two orbits. An orbital ring with the same inclination as the radar (35.1 deg) and possibly another orbital band with a much higher inclination of 66 deg are identified as being richest in space debris.
ESA

N92-25671*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VLA/GOLDSTONE (CALIFORNIA) PLANETARY RADAR RESULTS **c91**
A. W. Grossman, D. O. Muhleman, M. A. Slade, and B. J. Butler (California Inst. of Tech., Pasadena.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 19-22 Sponsored

by NASA, Washington (For primary document see N92-25668 16-32)
(Grant NSF AST-91-00306)
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Recent results from an entirely new technique of planetary radar astronomy are presented. The Very Large Array (VLA)/Goldstone planetary radar combines the transmitter of the Goldstone antenna and the receivers of the VLA interferometer to create a synthesis imaging radar instrument with unprecedented capabilities. The technique yields improved sensitivity and produces a direct sky map of radar flux density while avoiding the ambiguities associated with conventional range Doppler mapping. The method is illustrated by application to radar mapping of Mars and radar detection of Titan. ESA

N92-25672*# Stanford Univ., Palo Alto, CA. Center for Radar Astronomy.
BISTATIC RADAR STUDIES OF THE PLANETS **c91**
Ivan R. Linscott, G. Leonard Tyler, Essam A. Marouf, and Richard A. Simpson *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 23-29 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

The use of bistatic radar for planetary studies is discussed with the objective of presenting important, new capabilities for spaceborne systems. The success of bistatic radar, as a probe of the solar system's planets and moons, is reviewed. The relevance of new micropower and signal processing technologies is assessed, and the scientific opportunities for extending the study of planetary surfaces, atmospheres, and rings are presented. Ground based and spaceborne systems are discussed. The study of planetary surfaces, atmospheres, and rings is reviewed. The opportunities presented by the Next Generation Explorer (NGE) equipped with these new technologies are summarized. ESA

N92-25673*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MAGELLAN MISSION DESCRIPTION AND RADAR SYSTEM **c91**
William T. K. Johnson *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 33-38 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

The Magellan radar mission to Venus has collected and processed radar data from the spacecraft in an elliptical orbit around the planet. This multimode radar is the only science instrument on the mission and had the objective of mapping at least 70 percent of the planet surface during the primary mission or first cycle of 243 days. The spacecraft was launched in May 1989 and arrived at Venus in Aug. 1990. A few weeks later, the mapping of the planet began. During the first cycle of mapping, nearly 84 percent of the surface was mapped. The second cycle operation, taking place now, is filling in some of the areas missed during the first cycle and also using the radar in some nonstandard imaging modes. The radar has three modes: synthetic aperture radar (SAR), altimetry, and passive radiometry. The radar system has produced maps of almost all of the Venusian surface with a resolution better than 600 m equivalent optical line pair. The system design and operation required to produce the high resolution images are described. ESA

N92-25674# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
RESULTS FROM THE MAGELLAN ALTIMETER **c91**
Peter G. Ford, Gordon H. Pettengill, and Fang Liu *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 39-44 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

During the nominal Magellan mission, the altimeter has made some 3 million measurements of the Venus surface, arranged into a set of 'footprints' covering the latitude range from 85 degrees north to 80 degrees south. Range correlation, Doppler filtering, multiburst summation, and range migration are used in order to focus the data. Maps were prepared showing the global distribution of topography, meter scale slope, and power reflection coefficient. The results are similar to those reported on previous experiments: the surface radius exhibits a unimodal distribution with more than 70 percent of the surface lying within 1 km of the mean radius, but the higher resolution of the Magellan altimeter has disclosed several surprisingly steep features, e.g., the west face of Maxwell Montes, the southern face of Danu Montes, and chasmata to the east of Thetis Regio, where average kilometer scale slopes of greater than 30 deg are not uncommon. This conclusion is corroborated by close inspection of synthetic aperture radar (SAR). ESA

N92-25675# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
VENUS: SURFACE DIELECTRIC PROPERTIES **c91**
Gordon H. Pettengill and Peter G. Ford *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 45-48 (For primary document see N92-25668 16-32)
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Observations of radiothermal emission, radar reflectivity, made both from the Earth and from Venus orbiting spacecraft, have disclosed localized areas of high effective dielectric permittivity on the surface of Venus. In parts of Maxwell Mons and in some highland portions of Aphrodite Terra, the 12 cm wavelength surface radioemissivity drops to values as low as 0.30, accompanied by a radar power reflection coefficient approaching 0.65. These internally consistent but unusual results imply an effective dielectric permittivity in excess of 80, a value which stands in contrast to approximately 5 for most lowland regions of Venus. In the absence of liquid water (known not to exist on the hot surface of Venus), such high values of permittivity are unexpected, and most likely arise from the presence of small, electrically conducting inclusions in a host dielectric, producing a loaded dielectric. ESA

N92-25676# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
MARS 96 SUBSURFACE RADAR **c91**
Y. Barbin, W. Kofman, M. Elkine, M. Finkelstein, V. Glotov, and V. Zolotarev (Academy of Sciences of the Latvian SSR, Riga.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 51-58 Sponsored by CNES and Academy of Sciences Space Research Inst. (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

The Mars 96 International Scientific Mission to launch an aerostat that will drift in the Martian atmosphere for ten days is described. The stabilizing element of the aerostat (guiderope) will be dragged on the Martian surface every night. A ground penetrating radar will be installed within the guiderope. Its external surface will act as a transmit and receive antenna. A full scale model was built and tested on different soils and glaciers. Further experiments will be performed to test the full specifications. Radar potential and data processing could yield a penetrating depth down to 2.5 km with 30 m resolution on Mars. The main technical features of the radar are described. Its implementation into the guiderope is discussed. Some experimental results are presented. ESA

N92-25677# Centre National d'Etudes Spatiales, Toulouse (France). Radar Dept.
DEFINITION OF A L-BAND SAR FOR A MARS ROVER MISSION **c91**
A. Lifermann and E. Thouvenot *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 59-63 (For primary document see N92-25668 16-32)
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Within the framework of the Automatic Planetary Rover Program a radar with surface and subsurface imagery capabilities is proposed both for scientific applicatcns (30 to 100 m resolution imagery with typical penetration of 10 m) and as additional support to the rover in providing it with information about terrain roughness at relevant scale. The SAR (synthetic aperture radar) frequency is to be selected in the range 500 MHz to 1 GHz. The design of the

instrument within the mission constraints is considered in terms of data rate transmission, power, and antenna size. It is shown that the upper frequency band called for a 3.7 m diameter reflector while the lower fequencies require unfurlable antennas. The feasibility and mass of the latter antennas are more critical considering the planetary mission constraints. ESA

N92-25678# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Inst. d'Astrophysique Spatiale.
IN-SITU DOPPLER VELOCIMETRY OF VERY LARGE GRAINS: AN ESSENTIAL GOAL FOR FUTURE COMETARY INVESTIGATIONS **c90**
J. F. Crifo *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 65-70 (For primary document see N92-25668 16-32)
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The essential role played by solid grain ejection velocity in several critical fields of cometary investigation is recalled. Comparison between the various approximating expressions currently in use for this velocity reveals severe discrepancies. Recent indirect determinations based on model fits to dust tail images yield values which conflict with all these expressions. Both these theoretical expressions and these indirect determinations are argued to yield unreliable results, especially for large (cm sized and larger) grains. Future efforts along the same lines are not expected to provide significant improvements, because key information about the detailed structure of the nucleus surface and the dispersion in physical properties of the grains is not accessible. Direct in situ Doppler velocimetry of large grains from comet rendezvous spacecrafts, thus, appears as a potentially essential goal for future comet rendezvous missions. ESA

N92-25679# Nice Univ. (France).
ASTRA: ALTIMETRY AND SOUNDING OF TITAN WITH A RADAR ON A DESCENDING CRAFT **c91**
P. Kamoun, J. C. Anne, and Peter G. Ford (Massachusetts Inst. of Tech., Cambridge.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 71-78 (For primary document see N92-25668 16-32)
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A small altimetric and sounding radar instrument to observe and characterize the surface of Titan from a descending craft is proposed. It is a simple lightweight and cheap instrument with high scientific return. It could be very useful in gaining more information concerning the surface and subsurface of Titan. When associated with the same probe trajectory control, the ASTRA instrument could minimize the risk of landing in unsuitable terrain. ESA

N92-25680# Italian Space Agency, Rome. Centro di Geodesia Spaziale.
THE ITALIAN INVOLVEMENT IN CASSINI RADAR
F. Nirchio, B. Pernice, L. Borgarelli, and C. Dionisio (Alenia Spazio S.p.A., Rome, Italy) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 79-81 (For primary document see N92-25668 16-32)
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The Radio Frequency Electronic Subsystem (RFES) of the Cassini radar is described. The requirements of the Cassini radar are summarized. The design parameters taken into consideration in developing the RFES are described. The RFES interfaces with the High Gain Antenna (HGA) for signal transmission and reception. The operational parameters of the Cassini radar are presented. The front end electronics (FEE), microwave receiver (MR), high power amplifier (HPA), frequency generator (FG), digital chip generator (DCG), Chirp Up Converter and Amplifier (CUCA) and power supply of the RFES are described. ESA

N92-25681# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE RADARS ON ERS-1
Georg Graf *In its* Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 83-87 (For primary document see N92-25668 16-32)
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ERS-1 has three radars on board: a synthetic aperture radar (SAR), for imaging of sea, ice, and land; a wind scatterometer which, via the radar echo from the sea surface, measures wind speed and wind direction; and a radar altimeter which, in ocean mode, measures sea level, significant wave height, and wind speed, and in ice mode measures ice height around the poles and height profiles over land. Details concerning the operational parameters of the three radars are presented. Examples of data presentation from each type of radar are shown. ESA

N92-25682# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). R. F. Systems Div.
ERS-1 FOLLOW-ON RADARS AT ESA
D. Maccoll *In its* Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 89-92 (For primary document see N92-25668 16-32)
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Work in preparing radars to be flown on the ERS-2 and polar platform missions is described. Emphasis is placed on continuity and extending the range of products offered by the ERS-1 satellite. The primary instruments remain the radar altimeter, the synthetic aperture radar, and the scatterometer. Interesting technical developments which will improve performance are described. The radar work for other platform is discussed. ESA

N92-25683# Centre National d'Etudes Spatiales, Toulouse (France).
POSEIDON RADAR ALTIMETER FLIGHT MODEL DESIGN AND TEST RESULTS
P. Raizonville, B. Cugny, O. Z. Zanife, Y. Jaulhac, and J. Richard (Alcatel Espace, Toulouse, France) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 93-98 (For primary document see N92-25668 16-32)
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The design of the Poseidon solid state radar altimeter with emphasis on the result obtained during the flight model ground tests is discussed. The design of the altimeter is based on a solid state technology for the power amplifier implying the use of a long chirp pulse with a very high time-bandwith product. The major interface features of the instrument are given (mass, power, and dimensions) and the results obtained during the flight model tests are presented. Several electrical and system parameters are given. The signal processing of the instrument is described. Comparison is made with performances predicted through software simulation. Good agreement is found between the measurements and the simulation. A global accuracy budget is given. ESA

N92-25684# Canada Centre for Remote Sensing, Ottawa (Ontario).
CANADA'S RADARSAT PROGRAMME
R. Keith Raney (Canadian Space Agency, Ottawa, Ontario) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 99-106 (For primary document see N92-25668 16-32)
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The technical characteristics of the C band synthetic aperture radar (SAR) to be carried aboard the Radarsat mission are summarized. It is capable of imaging swaths from 35 to 500 km wide, with associated resolution from 10 (one look) to 100 m (8 looks). The incident angles span from 20 to more than 50 deg. The spacecraft is being designed for a five year lifetime, to be launched early in 1995 by NASA. Nominal SAR on-time is up to 28 minutes per orbit which may consist of up to seven individual data takes. The orbit is planned for 800 km (nominal), Sun synchronous, dawn dusk, and 24 day repeat with a seven day (approximate) subcycle. The SAR looks to the north but the spacecraft may be yawed through 180 deg for short portions of the mission in order to obtain images of Antarctica. With the onboard tape recorders, C band SAR imagery of the entire globe

may be gathered by Radarsat. There are two 100 MHz downlinks at X band. ESA

N92-25685# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
LASER SENSORS FOR PLANETARY RESEARCH: ESA INSTRUMENT DEVELOPMENT
R. Flatscher and Martin F. Hueber (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 109-116 (For primary document see N92-25668 16-32)
(Contract ESTEC-9230/90/NL/PB(SC))
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The requirements of exploratory missions to celestial bodies are translated into specific laser sensor requirements and constraints. Typical equipment actually used or foreseen is reviewed and characterized. Possible laser instrumentation concepts are defined. A comparison of the performance of these configurations is provided in parametric form. A set of representative planetary missions are used in selecting an advanced sensor concept offering modularity and multifunctionality. Two different laser heads sharing common optics are proposed. ESA

N92-25686# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
EUROPEAN SPACE AGENCY LIDAR TECHNOLOGY PROGRAMME
Martin F. Hueber *In its* Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 117-121 (For primary document see N92-25668 16-32)
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The preparatory efforts of ESA in the area of laser remote sensing are described. Main emphasis in technology development is placed on the achievement of efficient and powerful laser sources with the required levels of beam quality, reliability, and lifetime. Activities include the development of flash lamp and diode pumped Nd:YAG lasers for backscatter lidar, CO2 lasers for Doppler wind lidar, and rare earth solid state laser activities for Doppler wind lidar and DIAL (Differential Absorption Lidar) applications. At instrument level, priority is given to the development of an Atmospheric backscatter Lidar (ATLID), a promising first candidate for early space implementation. ESA's preparatory steps towards a space qualifiable instrument demonstrator of ATLID are described. Results from related user studies and campaigns are presented. ESA

N92-25687# Groupe de Recherche de Geodesie Spatiale, Grasse (France).
THE POTENTIAL OF TWO COLOR LASER RANGING
J. Gaignebet and G. Lund (Aerospatiale, Cannes, France) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 123-127 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

Laser ranging as a tool for high accuracy range determination is discussed. The advantages of the technique include good definition of the reference points of the vector to be measured (emission, reception, and target) and predictable and precise models enabling appropriate corrections to be applied to the refractive index effects of the traversed atmosphere. The weak point of this method is its dependence on weather and local visibility conditions (Earth - Space or Earth - Earth measurements). Two different long distance laser ranging techniques are compared. Refraction correction, two color laser ranging, ranging accuracy, and other parameters of the techniques are discussed. ESA

N92-25688# Societe Europeenne de Systemes Optiques, Aix-en-Provence (France).
LIRA: A NEW RAYLEIGH LIDAR SYSTEM
Michel Detaille *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 129-131 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

The Rayleigh lidar concept based on the Rayleigh scattering measurement is described. The Rayleigh lidar is used in measuring atmospheric density and temperature up to 90 km in altitude. It can be used for several applications such as space device assistance, constitution of a statistical data bank of the atmosphere, and the study of physicochemical phenomena in the atmosphere. The transportable potential of the LIRA system is outlined. The use of the lidar in carrying out accurate analysis of the Antarctic ozone hole is discussed. ESA

N92-25689# Electro Optic Systems Proprietary Ltd., Erindale (Australia).
SOLID STATE LASERS FOR PLANETARY EXPLORATION
Abstract Only
Ben Greene, Matthew Taubman, Barry Luther-Davies, Jeffrey Watts, and Gary Gaither (McDonnell-Douglas Electronics Co., Saint Louis, MO.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 133 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

Design and performance data for two laser transmitters for spaceborne laser ranging are presented. The first laser uses a master oscillator/power amplifier configuration consisting of a diode pumped Nd:YAG slab ring and a multipass diode pumped slab amplifier which can operate at 40 Hz for more than ten to the ninth shots. The other laser is a diode pumped Nd:YAG slab standing wave oscillator which operates at 10 Hz for more than 0.6 x 10 exp 9 shots. The lasers were specifically developed for reliability, for use in space exploitation of the Earth and nearby planets. Applications include planetary altimetry of Mars (MOLA) and Earth (GLRS), as well as space geodesy, navigation, and tracking. ESA

N92-25690# University Coll., London (England). Dept. of Electronic and Electrical Engineering.
TOPOGRAPHY FROM PULSE-LIMITED ALTIMETER ECHOES
c43
Duncan Wingham *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 137-140 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

First results of a method for inverting altimeter echoes that properly takes account of the finite resolution of the altimeter are presented. The assumptions of the method are described, and some early results for an ERS-1 type altimeter are presented. The need to further explore the error behavior in the parameter space available is stressed. It is concluded that the theory of altimeter inversion is fairly complete, taking the principal instrument characteristics into account. The altimeter beam, speckle noise, along-track filtering, and spatial irregularity of the sampling and orbit error are taken into consideration. ESA

N92-25691# Institut Geographique National, Paris (France).
DIGITAL TERRAIN MODELS FROM RADAR IMAGES: A REVIEW
Laurent Polidori *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 141-146 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

Three techniques for generating a digital terrain model from radar images are presented. These techniques are radargrammetry, radarclinometry, and interferometry. Radargrammetry aims at computing terrain elevations from pixel locations in two overlapping images. Radarclinometry derives surface orientation from radar backscattering cross-sections. Interferometry is used to determine height variations from phase variations. The performances and the practical constraints of these techniques are compared, and their complementarity is discussed. ESA

N92-26015*# Rockwell International Science Center, Thousand Oaks, CA.
MAGNETIC FIELD EFFECTS ON MICROWAVE ABSORBING MATERIALS Final Report, 1 Nov. 1988 - 31 Jan. 1990
Ira Goldberg, Charles S. Hollingsworth, and Ted M. McKinney Apr. 1991 73 p Prepared for Ohio State Univ., Columbus Original contains color illustrations
(Grant NsG-1613)
(NASA-CR-190347; NAS 1.26:190347; SC73001.FR) Avail: NTIS HC/MF A04; 10 functional color pages

The objective of this program was to gather information to formulate a microwave absorber that can work in the presence of strong constant direct current (DC) magnetic fields. The program was conducted in four steps. The first step was to investigate the electrical and magnetic properties of magnetic and ferrite microwave absorbers in the presence of strong magnetic fields. This included both experimental measurements and a literature survey of properties that may be applicable to finding an appropriate absorbing material. The second step was to identify those material properties that will produce desirable absorptive properties in the presence of intense magnetic fields and determine the range of magnetic field in which the absorbers remain effective. The third step was to establish ferrite absorber designs that will produce low reflection and adequate absorption in the presence of intense inhomogeneous static magnetic fields. The fourth and final step was to prepare and test samples of such magnetic microwave absorbers if such designs seem practical. H.A.

N92-26040# Georgia Inst. of Tech., Atlanta.
TRANSFORM-BASED WIDEBAND ARRAY PROCESSING Semiannual Performance Report, 1 Aug 1991 - 31 Jan. 1992
Douglas B. Williams and Rabinder N. Madan 31 Jan. 1992 9 p
(Contract N00014-91-J-4129)
(AD-A245873) Avail: NTIS HC/MF A02

This contract has funded two projects in full and one project in part. The two fully funded projects focus on the application of random coefficient models to wideband high-resolution direction finding and transient signal detection and estimation. The partially funded project involves the analysis of nonlinear, possibly chaotic, dynamical systems. It has been shown that the random coefficient model is much better suited to modeling sensor array data than the autoregressive model is. Application of the wavelet transform to the detection of transient signals with an array of sensors is being examined. This approach has led to a directional multirate filter bank structure that decomposes the incoming signal into decaying exponentials. System identification algorithms that depend on gradient descent methods have been found to degrade significantly if the time-series or, equivalently, the system that produced the time-series is chaotic. A careful analysis of these degradations has led to algorithms which are much less sensitive to the potentially chaotic nature of these nonlinear systems. GRA

N92-26083*# Research Inst. for Computing and Information Systems, Houston, TX.
REPORTS ON WORK IN SUPPORT OF NASA'S TRACKING AND COMMUNICATION DIVISION Interim Report, 1 Oct. - 31 Dec. 1991
Terry Feagin and Anthony Lekkos (Houston Univ., Clear Lake, TX.) 31 Dec. 1991 18 p
(Contract NCC9-16; RICIS Proj. AI-01)
(NASA-CR-190386; NAS 1.26:190386) Avail: NTIS HC/MF A03

This is a report on the research conducted during the period October 1, 1991 through December 31, 1991. The research is divided into two primary areas: (1) generalization of the Fault Isolation using Bit Strings (FIBS) technique to permit fuzzy information to be used to isolate faults in the tracking and communications system of the Space Station; and (2) a study of the activity that should occur in the on board systems in order to attempt to recover from failures that are external to the Space Station. H.A.

N92-26114*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
TIME DOMAIN SCATTERING AND RADAR CROSS SECTION CALCULATIONS FOR A THIN, COATED PERFECTLY CONDUCTING PLATE
Raymond J. Luebbers and John H. Beggs Feb. 1991 10 p
(Grant NAG1-1221)
(NASA-CR-190106; NAS 1.26:190106) Avail: NTIS HC/MF A02

Radar cross section (RCS) calculations for flat, perfectly conducting plates are readily available through the use of conventional frequency domain techniques such as the Method of Moments (MOM). However, if the plate is covered with a dielectric material that is relatively thick in comparison with the wavelength in the material, these frequency domain techniques become increasingly difficult to apply. The application is presented of the Finite Difference Time Domain (FDTD) technique to the problem of electromagnetic scattering and RCS calculations from a thin, perfectly conducting plate that is coated with a thick layer of lossless dielectric material. Both time domain and RCS calculations are presented and discussed. Author

N92-26132*# Michigan Univ., Ann Arbor. Radiation Lab.
EDGE-BASED FINITE ELEMENTS AND VECTOR ABCs APPLIED TO 3D SCATTERING Technical Report, Feb. - Sep. 1992
A. Chatterjee, J. M. Jin, and John L. Volakis May 1992 20 p Sponsored in part by Pacific Missile Test Center
(Grant NAG2-541)
(NASA-CR-190352; NAS 1.26:190352; UMICH-025921-29-T)
Avail: NTIS HC/MF A03

An edge based finite element formulation with vector absorbing boundary conditions is presented for scattering by composite structures having boundaries satisfying impedance and/or transition conditions. Remarkably accurate results are obtained by placing the mesh a small fraction of a wavelength away from the scatterer. Author

N92-26167# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
PERTURBATION THEORY FOR A CAVITY RESONATOR WITH A BIISOTROPIC SAMPLE: APPLICATIONS TO MEASUREMENT TECHNIQUES
S. A. Tretyakov and A. J. Viitanen Oct. 1991 10 p Sponsored by Suomen Akatemja, Helsinki
(PB92-143346; ISBN-951-22-0826-1; Rept-104) Avail: NTIS HC/MF A02

Resonator measurement techniques for exploring electromagnetic parameters of biisotropic (nonreciprocal chiral) materials are discussed. The biisotropic materials are the most general linear isotropic materials and the corresponding constitutive relations are governed by four parameters. A theory of resonator measurement techniques, based on the perturbation analysis, is developed. It is shown that the complex permittivity, permeability, and the nonreciprocity parameter of a small sample can be determined by measuring resonant frequency shifts in a rectangular resonator. To measure the nonreciprocity parameter, a method using a rectangular resonator with two degenerated modes is proposed. GRA

N92-25622# Japan Resources Observation System Organization.
SAR DEVELOPMENT STATUS
Yukiaki Nemoto *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 7-18 (For primary document see N92-25620 16-43)
(EW-2) Avail: NTIS HC/MF A08

N92-25771# Helsinki Univ. of Technology, Espoo (Finland). Teoreettisen Fysiikan Laitos.
RADAR MEASUREMENT OPTIMIZATION [TUTKAMITTAUSTEN OPTIMOINTI]
Markku S. Lehtinen *In* Oulu Univ., Second Meeting of Finnish

Space Researchers 1990 p 27-28 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25776# Oulu Univ. (Finland). Fysiikan Laitos.
EISCAT RESEARCH IN FINLAND [EISCAT-TUTKIMUS SUOMESSA]
Tuomo Nygren *In its* Second Meeting of Finnish Space Researchers 1990 p 37-38 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25784# Helsinki Univ. of Technology, Espoo (Finland). Radiolab.
RESEARCH PROJECTS ON SATELLITE TELECOMMUNICATION AT THE TKK (FINLAND) [SATELLIITTITIETOLIIKENTEEN TUTKIMUSPROJEKTIT TKK:SSA]
Erkki Salonen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 59-60 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N92-25176*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF InAlAs WINDOW LAYER ON EFFICIENCY OF INDIUM PHOSPHIDE SOLAR CELLS
Raj K. Jain and Geoffrey A. Landis (Sverdrup Technology, Inc., Brook Park, OH.) 1992 8 p Presented at the 22d Photovoltaic Specialists Conference, Las Vegas, NV, 7-11 Oct. 1991; sponsored by IEEE
(NASA-TM-105354; E-6728; NAS 1.15:105354) Avail: NTIS HC/MF A02

Indium phosphide (InP) solar cell efficiencies are limited by surface recombination. The effect of a wide bandgap, lattice-matched indium aluminum arsenide (In(0.52)Al(0.48)As) window layer on the performance of InP solar cells was investigated by using the numerical code PC-1D. The p(+)n InP solar cell performance improved significantly with the use of the window layer. No improvement was seen for the n(+)p InP cells. The cell results were explained by the band diagram of the heterostructure and the conduction band energy discontinuity. The calculated current voltage and internal quantum efficiency results clearly demonstrated that In(0.52)Al(0.48)As is a very promising candidate for a window layer material for p(+)n InP solar cells. Author

N92-25180 Politecnico di Milano (Italy). Dipartimento di Elettronica.
ANALYSIS OF NONLINEAR CIRCUIT SYSTEMS [ANALISI A REGIME DI RETI ELETTRICHE NON LINEARI]
William Fornaciari Nov. 1991 26 p In ITALIAN
(Rept-91-074; ETN-92-91260) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The method and problems involved in simulating circuit behavior are addressed and experimental results obtained during implementation of a technique for solving nonlinear circuit systems in the time domain using the Spice circuit simulator are reported. ESA

N92-25210# California Univ., Berkeley. Lawrence Berkeley Lab.
ZINC AIR BATTERY DEVELOPMENT FOR ELECTRIC VEHICLES
R. A. Putt and G. W. Merry (Metal Air Technology Systems International, Inc., Atlanta, GA.) Jul. 1991 26 p
(Contract DE-AC03-76SF-00098)
(DE92-009485; LBL-31184) Avail: NTIS HC/MF A03

This report summarizes the results of research conducted during the sixteen month continuation of a program to develop rechargeable zinc-air batteries for electric vehicles. The zinc-air technology under development incorporates a metal foam substrate for the zinc electrode, with flow of electrolyte through the foam during battery operation. In this 'soluble' zinc electrode the zincate discharge product dissolves completely in the electrolyte stream. Cycle testing at Lawrence Berkeley Laboratory, where the electrode was invented, and at MATSI showed that this approach avoids the zinc electrode shape change phenomenon. Further, electrolyte flow has been shown to be necessary to achieve significant cycle life (greater than 25 cycles) in this open system. Without it, water loss through the oxygen electrode results in high resistance failure of the cell. The Phase 1 program, which focused entirely on the zinc electrode, elucidated the conditions necessary to increase electrode capacity from 75 to as much as 300 mAh/sq cm. By the end of the Phase 1 program over 500 cycles had accrued on one of the zinc-zinc half cells undergoing continuous cycle testing. The Phase 2 program continued the half cell cycle testing and separator development, further refined the foam preplate process, and launched into performance and cycle life testing of zinc-air cells. DOE

N92-25212# Lawrence Livermore National Lab., CA.
MODELING THE EFFECT OF DEEP IMPURITY IONIZATION ON GaAs PHOTOCONDUCTIVE SWITCHES
J. H. Yee, G. H. Khanaka, R. L. Druce, and M. D. Pocha Jan. 1992 11 p Presented at the Optically Activated Switching 2, SPIE Laser and Radar Engineering Symposium, Los Angeles, CA, 19-24 Jan. 1992
(Contract W-7405-eng-48)
(DE92-009594; UCRL-JC-109781; CONF-920124-16) Avail: NTIS HC/MF A03

The ionization coefficient of deep traps in GaAs is determined from a gas breakdown model together with the recent experimental data obtained at LLNL (Lawrence Livermore National Laboratory) and Boeing. Using this coefficient in our nonlinear device transport code, we have investigated theoretically the nonlinear switching phenomena in GaAs devices. The results obtained from our investigations show that if we take into consideration the effect of the field ionization of the deep traps, we can show how the 'Lock-On' phenomena could occur in the device. DOE

N92-25222# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
DC CICC RETROFIT MAGNET PRELIMINARY DESIGN, PROTECTION ANALYSIS AND SOFTWARE DEVELOPMENT
J. H. Schultz, P. G. Marston, J. R. Hale, and A. M. Dawson Nov. 1991 10 p
(Contract DE-FG22-90PC-90350)
(DE92-008696; DOE/PC-90350/4) Avail: NTIS HC/MF A02

In the past few years, several computer codes have been written for the purpose of analyzing transient recovery and quench in internally-cooled cable-in-conduit superconductors (ICCS). These codes all include a transient, compressible helium flow model. They differ in the 'dimensionality' of the models, ranging from one- to three-dimensional finite element modeling of thermal conduction. The code used in this study, CICC, is a 1-(1/2) D code that models thermal conduction through the insulation of an individual conduit. Until recently, the calibration of CICC was restricted to measurements of helium expulsion in normal conductor. No actual quenches in ICCS coils had been simulated. In the past year, several experiments on ICCS conductors of differing topology have been performed and compared with CICC simulations, with varying success. This paper reports on the capability of CICC to predict and analyze ICCS recovery and quench, and on the code's limitations and need for further improvements. DOE

N92-25268*# Old Dominion Univ., Norfolk, VA.
SIMULATOR FOR CONCURRENT PROCESSING DATA FLOW ARCHITECTURES Contractor Report, 1 Mar. 1990 - 28 Feb. 1991
Mahyar R. Malekpour, John W. Stoughton, and Roland R. Mielke Mar. 1992 137 p
(Contract NCC1-136)
(NASA-CR-189604; NAS 1.26:189604) Avail: NTIS HC/MF A07

A software simulator capability of simulating execution of an algorithm graph on a given system under the Algorithm to Architecture Mapping Model (ATAMM) rules is presented. ATAMM is capable of modeling the execution of large-grained algorithms on distributed data flow architectures. Investigating the behavior and determining the performance of an ATAMM based system requires the aid of software tools. The ATAMM Simulator presented is capable of determining the performance of a system without having to build a hardware prototype. Case studies are performed on four algorithms to demonstrate the capabilities of the ATAMM Simulator. Simulated results are shown to be comparable to the experimental results of the Advanced Development Model System. Author

N92-25307# Technische Univ., Delft (Netherlands).
VORTEX DYNAMICS IN ARTIFICIALLY FABRICATED SUPERCONDUCTING NETWORKS Ph.D. Thesis
Herre Sjoerd Jan vanderZant 1991 138 p
(ETN-92-91296) Avail: NTIS HC/MF A07

An experimental study on vortex dynamics in artificially fabricated superconducting networks is presented. The measurements concentrated on electrical transport properties. The resistance of these superconducting networks was measured as a function of temperature, magnetic field, and applied current. The following studies are presented: vortex dynamics in Josephson junction arrays; the superconducting transition of two dimensional Josephson junction arrays in a small perpendicular magnetic field; phase transition of frustrated two dimensional Josephson junction arrays; phase fluctuations in two dimensional superconducting weakly coupled wire networks; coherent phase slip in arrays of underdamped Josephson tunnel junctions; dynamics of vortices in underclamped Josephson junction arrays; ballistic vortices in Josephson junction arrays; and quantum vortices near the field tuned transitions in Josephson junction arrays. ESA

N92-25409# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
RESEARCH ON STABLE, HIGH EFFICIENCY AMORPHOUS SILICON MULTIJUNCTION MODULES Semiannual Progress Report, 1 May - 31 Oct. 1991
A. Catalano, R. R. Arya, M. Bennett, L. Chen, R. DAiello, B. Fieselmann, Y. Li, J. Newton, R. Podlesny, and S. Wiedeman et al Feb. 1992 101 p Prepared in cooperation with Solarex Corp., Newtown, PA
(Contract DE-AC02-83CH-10093)
(DE92-001213; NREL/TP-451-4720) Avail: NTIS HC/MF A06

Improvements towards a goal of a 12.5 percent initial triple-junction module efficiency require the use of a wide gap top-layer for improved open circuit voltage, higher transmission from the transparent front contact and more highly transmitting doped layers. To address the first issue, there has been continued development of a-SiC:H with the utilization of several novel feedstocks to control the atomic structure of the solid. These films have transport properties superior to the best results reported for a-SiC:H. Preliminary results with devices exhibits a stability comparable to a-Si:H, while previous results with a-SiC:H have generally shown for higher rates of degradation. Module fabrication has been refined to the extent that comparable module and small area device efficiencies are readily obtained. Despite the high initial efficiencies (9 to 10 percent) obtained in 935 cm(exp 2) modules employing devices with 4000 A thick middle junctions, higher than expected rates of degradation were found. The cause of the anomalous degradation was traced to shunts present in the device arising from defects in the tin oxide coating. NREL degradation results of triple-junction modules showed stabilized performance of the initial efficiency for modules prepared during the period in which shunts were a problem. DOE

N92-25544# CALS/CE, Washington, DC. Industry Steering Group.
FIRST PRINCIPLES OF CONCURRENT ENGINEERING: A COMPETITIVE STRATEGY FOR ELECTRONIC PRODUCT DEVELOPMENT. CALS/CONCURRENT ENGINEERING TASK GROUP-ELECTRONIC SYSTEMS
L. Linton, D. Hall, K. Hutchison, D. Hoffman, and S. Evanczuk 30 Sep. 1991 181 p
(PB92-102524; CALS-TR-005) Avail: NTIS HC/MF A09

The U.S. electronics industry is in trouble. Progressively more electronic components and critical technologies are available only from foreign sources. The problems of maintaining a sufficient level of military readiness and a competitive commercial electronics industry to support a healthy economy are directly linked. The majority of problems are directly related to inherent insufficiencies in the way the products are engineered and the processes that manufacture, test, and support them. Outlined here are the principles of current engineering for electronics development. The competitive strategy is part of the Computer-aided Acquisition and Logistic Support (CALS) system. Author

N92-25637 California Univ., San Diego.
COMPOSITIONALLY-GRADED In(x)Al(1-x)As (x LESS THAN OR EQUAL TO 0.52) QUASI-INSULATOR FOR HETEROJUNCTION GATED FIELD-EFFECT TRANSISTOR APPLICATIONS Ph.D. Thesis
Phang-Zong Lee 1991 165 p
Avail: Univ. Microfilms Order No. DA9209630

This work is an experimental investigation of a new quasi-insulator structure intended for constructing large dynamic range, high linearity, heterojunction insulated gate field-effect transistors (HIGFETs) on InP substrates. This type of device was found to have great potential in broadband, large signal applications in long-wavelength optical and ultra-high-speed microwave telecommunications. To achieve this goal, the quasi-insulator must be able to provide the highest possible Schottky barrier height, highest possible conduction-band offset (for n-channel device), and good interface properties. Thus the focus of this dissertation is on the characterization of the electrical properties of the new quasi-insulator. The heterojunction system chosen for this study consists of an undoped, charge-depleted In(x)Al(1-x)As(x less than 0.52) as a quasi-insulator on a Si-doped n-In(0.53)Ga(0.47)As semiconducting channel layer. These layers are grown on InP substrates by means of molecular beam epitaxy (MBE) technique. A study of lattice-matched and strained n-isotype (N-n junction) In(x)Al(1-x)As(x less than 0.52)/In(0.53)Ga(0.47)As heterojunctions (HJs) using capacitance-voltage (C-V) profiling technique suggests that their conduction-band offsets (Delta(E)(sub c)) can be increased by an increase of the AlAs molar concentration of In(x)Al(1-x)As. The variation of Delta(E)(sub c) as a function of aluminum molar fraction is also derived throughout this investigation. C-V measurements performed on a metal-insulator-semiconductor (MIS) structure are used as a tool to characterize the interface properties of the In(x)Al(1-x)As(x less than 0.52)/In(0.53)Ga(0.47)As heterojunctions (HJs). Experimental data obtained from this measurement suggests that a possible deterioration of interface properties may occur at the HJ made of a single layer of uniformly strained In(x)Al(1-x)As(x less than 0.52) and In(0.53)Ga(0.47)As. A lattice-matched In(0.52)Al(0.48)As gate buffer layer is then inserted between the strained In(x)Al(1-x)As(x less than 0.52) and In(0.53)Ga(0.47)As in order to eliminate this problem. Dissert. Abstr.

N92-25756# Allied-Signal Aerospace Co., Kansas City, MO.
RAISED LAND SUSCEPTIBILITY OF MULTIFUNCTIONAL EPOXY/GLASS MULTILAYER PRINTED WIRING BOARDS
J. W. Lula Mar. 1992 17 p
(Contract DE-AC04-76DP-00613)
(DE92-010073; KCP-613-4660) Avail: NTIS HC/MF A03

Three multifunctional epoxy/glass printed wiring board (PWB) laminates, along with standard FR4 laminate from production stores, were evaluated for their susceptibility to raised lands around the plated through-holes of PWBs. However, after thermal stress tests, the angles of the lands were measured in relation to the PWB surface, and the results were surprisingly similar. None of the materials that were tested stood out as being far better than the others in regard to reduced raised land susceptibility. Judging from the Z-axis thermal expansion curves, the similar average and angles measured after thermal stress tests, and rework simulation tests, it was not evident that any of these multifunctional epoxy systems would resolve the recurring problem of raised lands on channel-plated PWB product at Allied-Signal Inc., Kansas City Division. DOE

N92-25795# Sandia National Labs., Albuquerque, NM.
PROCEEDINGS OF THE THIRD SWITCH TUBE ADVANCED TECHNOLOGY REVIEW MEETING
L. C. Beavis Feb. 1992 181 p Presented at the 3rd Switch Tube Advanced Technology Review Meeting, Salem, MA, 9 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-009393; SAND-91-2872; CONF-9110349-Absts) Avail: NTIS HC/MF A09

The Third Switch Tube Advanced Technology Review (ATR) was held at EG&G Salem, MA on October 9, 1991. This document is a compilation of the abstracts, viewgraphs, and written materials supplied by the presenters from Allied Signal Kansas City Division (ASKCD), EG&G Salem, and Sandia National Laboratories (SNL). As this document is intended as a reference for the attendees and those familiar with switch tube technology, it has not been reviewed or edited in any way. It is not intended to be generally circulated. Included in this document is the final agenda of the meeting and a list of attendees. Various facets of fabrication and performance of carbon coatings, Kovar, and other materials are discussed. DOE

N92-25806# Brookhaven National Lab., Upton, NY.
THE BROOKHAVEN ELECTRON ANALOGUE, 1953 - 1957
M. Plotkin 18 Dec. 1991 112 p
(Contract DE-AC02-76CH-00016)
(DE92-009154; BNL-45058; AGS/AD-91/3) Avail: NTIS HC/MF A06

The following topics are discussed on the Brookhaven electron analogue: L.J. Haworth and E.L. VanHorn letters; Original G.K. Green outline for report; General description; Parameter list; Mechanical Assembly; Alignment; Degaussing; Vacuum System; Injection System; The pulsed inflector; RF System; Ferrite Cavity; Pick-up electrodes and preamplifiers; Radio Frequency power amplifier; Lens supply; Controls and Power; and RF acceleration summary. DOE

N92-26032# Naval Postgraduate School, Monterey, CA.
THE DEVELOPMENT OF A THERMAL ANALYSIS MODEL BUILDER FOR A PRINTED CIRCUIT BOARD M.S. Thesis
Stephen J. Glaser Sep. 1991 154 p
(AD-A245346) Avail: NTIS HC/MF A08

The Naval Postgraduate School possesses software designed to perform thermal analysis of electronic components. At the core of this package is a model builder whose purpose is to generate a thermal model for use in steady state and transient thermal analyzers. The current version of the model builder requires excessive amounts of time for data input and model verification. This thesis describes the development of a model builder specifically designed to reduce the time required to model a printed circuit board containing up to four copper layers. GRA

N92-26034# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
PREPARATION AND CHARACTERIZATION OF REDOX ACTIVE MOLECULAR ASSEMBLIES ON MICROELECTRODE ARRAYS Technical Report No. 44, 1990-1991
C. D. Frisbie, I. Fritsch-Faules, E. W. Wollman, and M. S. Wrighton 4 Feb. 1992 32 p
(Contract N00014-84-K-0553)
(AD-A245796) Avail: NTIS HC/MF A03

Microelectrode arrays, consisting of six or eight individually addressable Au or Pt microelectrodes about 2 microns wide, 50 um long, and 0.1 microns thick separated by about 2 microns on a Si3N4 substrate, can be modified by immersion into a solution containing molecules having thiol, dithiocarbamate, or disulfide functional groups. The functional groups yield selective modification of the gold or platinum, not the Si3N4, with about one monolayer of molecular reagents. Electrochemical and Auger electron spectroscopy (AES) data are summarized to illustrate that the dithiocarbamate functional group can be used to link redox active molecules to Au or Pt surfaces. GRA

N92-26084# RAND Corp., Santa Monica, CA.
AN ANALYSIS OF MILITARY AND COMMERCIAL MICROELECTRONICS: HAS DOD'S R AND D FUNDING HAD THE DESIRED EFFECT? Ph.D. Thesis
Anna Slomovic Feb. 1991 231 p Sponsored in part by Army and AF
(N-3318-RGSD) Avail: NTIS HC/MF A11

This research is an analysis of the military research and development (R&D) investment strategy in microelectronics. The period examined is the decade of the 1980s, a time when the military tried to remedy a perceived gap between the state of art in commercial and military microelectronics through a massive infusion of semiconductor R&D funds. The research looked at integrated circuits available for military and commercial applications, and used the comparison to evaluate the R&D investment strategy that led to the outcomes. The judgement about the past was used as a way of assessing the present and future R&D investment strategies. Author

N92-26088 Department of the Navy, Washington, DC.
HEAT SINK DEVICE FOR ELECTRONICS MODULES PACKAGED IN CYLINDRICAL CASINGS Patent
Mark W. Sewell, inventor (to Navy) 22 Oct. 1991 6 p Filed 28 Sep. 1990 Supersedes AD-D014736
(AD-D015187; US-Patent-5,060,115; US-Patent-Appl-SN-590186; US-Patent-Class-361-383) Avail: US Patent and Trademark Office

A device for dissipating heat from electronics encased in a circular housing is disclosed for uses in buoys, sonobuoys, mines and missiles. The device contains a heat dissipating ring that engages the inner surface of the cylindrical electronics case. The inside surface of this ring is tapered to receive a heat transfer disk that is pulled into tight union with the heat dissipating ring. A heat generating module is mounted in heat transfer union with the disk whereby excess heat is transferred from the disk through the ring to the electronics case where it is dissipated into the environment. Author (GRA)

N92-26096*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A 1-W, 30-GHz, CPW AMPLIFIER FOR ACTS SMALL TERMINAL UPLINK
Susan R. Taub and Rainee N. Simons (Sverdrup Technology, Inc., Brook Park, OH.) 1992 6 p Presented at the Monolithic Microwave Integrated Circuit Space and Ground Applications Symposium, Pasadena, CA, 28-29 Apr. 1992; sponsored by JPL
(Contract NAS3-25266)
(NASA-TM-105671; E-7037; NAS 1.15:105671) Avail: NTIS HC/MF A02

The progress is described of the development of a 1 W, 30 GHz, coplanar waveguide (CPW) amplifier for the Advanced Communication Technology Satellite (ACTS)Small Terminal Uplink. The amplifier is based on Texas Instruments' monolithic microwave integrated circuit (MMIC) amplifiers; a three stage, low power amplifier, and a single stage, high power amplifier. The amplifiers have a power output of 190 mW and 0.710 W, gain of 23 and 4.2 dB, and efficiencies of 30.2 and 24 percent for the three stage

and one stage amplifiers, respectively. The chips are to be combined via a CPW power divider/combiner circuit to yield the desired 1 W of output power. Author

N92-26119# Office of Technology Assessment, Washington, DC.
MINIATURIZATION TECHNOLOGIES
Nov. 1991 52 p Presented at the Miniaturization of Electronic and Mechanical Devices Workshop, 19 Feb. 1991
(OTA-TCT-514; ISBN-0-16-035983-X) Avail: NTIS HC/MF A04; also available SOD HC $3.25 as 052-003-01267-7

Various technologies are analyzed that may be important for future advances in miniaturization. Current research is pushing limits of miniaturization to the point that structures only hundreds of atoms thick will be commonly manufactured. Researchers studying atomic and molecular interactions are continuing to push the frontiers, creating knowledge needed to continue progress in miniaturization. Scientists and engineers are creating microscopic mechanical structures and biological sensors that will have novel and diverse applications. The U.S. remains strong in miniaturization technologies R&D, although the lead over other nations is less substantial than it has been in the past. The trends in silicon electronics miniaturization show no signs of slowing in the near future. The technology of semiconductor manufacturing is being applied to other fields to create new capabilities. Sensors created with semiconductor manufacturing technology hold the promise of widespread applications over the next 10 years. Packaging is playing an increasingly larger role in miniaturization of electronics. Author

N92-26168# EPITAXX, Inc., Princeton, NJ.
SIMPLE HIGH-PERFORMANCE AVALANCHE PHOTODIODE FOR LONG-WAVELENGTH OPTICAL COMMUNICATION Final Report
G. H. Olsen 15 Aug. 1991 51 p
(Grant NSF ISI-88-00482)
(PB92-145945; NSF/ISI-91011) Avail: NTIS HC/MF A04

The overall objective was to optimize a unique avalanche photodiode (APD) structure that is easy to fabricate, operates at up to 2 Gbit/s from 1000 to 1700 nm, and achieves sensitivity below -40 dbm. Specific objectives included: (1) completing two-dimensional modeling of potential distribution; (2) applying modeling results to device structure material parameters; (3) evaluating double-diffusion and ion-implanted structures; (4) varying geometry of ring structure and determining optimum breakdown configuration; and (5) demonstrating a reproducible structure which has avalanche gain above ten. A working floating guard ring indium gallium arsenide avalanche photodetector for fiber optic applications in the 1.0-1.7 micrometer spectrum was produced with uniform gains as high as 85, minimum dark current of 5 microns sq cm, and capacitance of 0.4 pF. Both experimental and theoretical results show that the structure prevents edge breakdown and greatly reduces electronic field along the semiconductor/insulator surface. GRA

N92-25852# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.
A HEAT SWITCH FOR SPACE CRYOCOOLER APPLICATIONS
S. VanOost, G. Bekaert, R. S. Bhatti, S. Scull, and C. I. Jewell (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 209-216 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25903# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
FORMATION OF A VERY LOW-REFLECTANCE SURFACE BY ELECTROSTATIC FLOCKING
A. Kato, A. Onishi, and T. Hayashi *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 565-568 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-25148*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE NONLINEAR DEVELOPMENT OF THE MOST UNSTABLE GOERTLER VORTEX MODE Final Report
James P. Denier and Philip Hall (Manchester Univ., England) Dec. 1991 34 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189576; NAS 1.26:189576; ICASE-91-86; AD-A244823) Avail: NTIS HC/MF A03

The nonlinear development of the most unstable Gortler vortex mode in boundary layer flows over curved walls is investigated. The most unstable Gortler mode is confined to a viscous wall layer of thickness O(G -1/5) and has spanwise wavelength O(G 11/5); it is, of course, most relevant to flow situations where the Gortler number G is much greater than 1. The nonlinear equations covering the evolution of this mode over an O(G -3/5) streamwise lengthscale are derived and are found to be of a fully nonparallel nature. The solution of these equations is achieved by making use of the numerical scheme used by Hall (1988) for the numerical solution of the nonlinear Gortler equations valid for O(1) Gortler numbers. Thus, the spanwise dependence of the flow is described by a Fourier expansion, whereas the streamwise and normal variations of the flow are dealt with by employing a suitable finite difference discretization of the governing equations. Our calculations demonstrate that, given a suitable initial disturbance, after a brief interval of decay, the energy in all the higher harmonics grows until a singularity is encountered at some downstream position. The structure of the flowfield as this singularity is approached suggests that the singularity is responsible for the vortices, which are initially confined to the thin viscous wall layer, moving away from the wall and into the core of the boundary layer. Author

N92-25196*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CONSERVATIVE-VARIABLE AVERAGE STATES FOR EQUILIBRIUM GAS MULTI-DIMENSIONAL FLUXES
G. S. Iannelli (Tennessee Univ., Knoxville.) Mar. 1992 46 p
(NASA Order C-99066-G)
(NASA-TM-105585; ICOMP-92-05; E-6913; NAS 1.15:105585)
Avail: NTIS HC/MF A03

Modern split component evaluations of the flux vector Jacobians are thoroughly analyzed for equilibrium-gas average-state determinations. It is shown that all such derivations satisfy a fundamental eigenvalue consistency theorem. A conservative-variable average state is then developed for arbitrary equilibrium-gas equations of state and curvilinear-coordinate fluxes. Original expressions for eigenvalues, sound speed, Mach number, and eigenvectors are then determined for a general average Jacobian, and it is shown that the average eigenvalues, Mach number, and eigenvectors may not coincide with their classical pointwise counterparts. A general equilibrium-gas equation of state is then discussed for conservative-variable computational fluid dynamics (CFD) Euler formulations. The associated derivations lead to unique compatibility relations that constrain the pressure Jacobian derivatives. Thereafter, alternative forms for the pressure variation and average sound speed are developed in terms of two average pressure Jacobian derivatives. Significantly, no additional

degree of freedom exists in the determination of these two average partial derivatives of pressure. Therefore, they are simultaneously computed exactly without any auxiliary relation, hence without any geometric solution projection or arbitrary scale factors. Several alternative formulations are then compared and key differences highlighted with emphasis on the determination of the pressure variation and average sound speed. The relevant underlying assumptions are identified, including some subtle approximations that are inherently employed in published average-state procedures. Finally, a representative test case is discussed for which an intrinsically exact average state is determined. This exact state is then compared with the predictions of recent methods, and their inherent approximations are appropriately quantified. Author

N92-25198# Massachusetts Univ., Amherst.
MIXING OF VISCOUS FLUIDS: BEHAVIOR OF MICROSTRUCTURES AND CHAOS
J. M. Ottino Jun. 1991 21 p
(Contract DE-FG02-85ER-13333)
(DE92-008945; DOE/ER-13333/7) Avail: NTIS HC/MF A03

The objective of the work has been to investigate, by computational and experimental means, the deformation, fragmentation, and dispersion of fluid drops advected by a chaotic flow; such flows mimic key features of real flows and offer the possibility of in-depth analysis and experimentation. Flow conditions which result in efficient breakup and dispersion of one mass of fluid in the bulk of another were investigated. Studies were carried in various classes of carefully controlled flows using well characterized fluid system spanning a wide range of viscosities and surface tensions. Other related studies focused on application of scaling techniques to problems involving general aspects of structure formation: coupling and competition between mixing, aggregation, breakup, and diffusional processes. DOE

N92-25209# Lawrence Livermore National Lab., CA.
MINISYMPOSIUM ON OUTFLOW CONDITIONS FOR INCOMPRESSIBLE FLOW Summary Report
P. M. Gresho Aug. 1991 9 p Minisymposium held in Palo Alto, CA, 14 Jul. 1991
(Contract W-7405-eng-48)
(DE92-008940; UCRL-JC-108157; CONF-910735-Summ) Avail: NTIS HC/MF A02

The OBC Minisymposium was centered around four test problems: (1) The (isothermal) backward facing step at Re = 800; (2) A stably-stratified flow version of (1) at Re = 800 = Pe and Fr = 16/9; (3) Vortex shedding past a cylinder at Re = 100; and (4) Poiseuille-Bernard traveling roll cells in a channel Re = 10, Pe = 20/3, Fr = 1/150. Benchmark solutions for each were published in Volume 11, No. 7 (November 1990) of the International Journal for Numerical Methods in Fluids. The purpose of the symposium was to bring together researchers from different numerical disciplines who have the common goal of improving the current situation with regard to OBC's and to find new better OBC's for all disciplines-assuming this to be possible. This was to be done by requiring that each participant solve the given problem two times: once on a long-enough domain and again on a definitely too-short domain. The better OBC's are those that deliver good results on both domains and cost little to implement. DOE

N92-25271# Lawrence Livermore National Lab., CA.
UNSTABLE WALL LAYERS CREATED BY SHOCK REFLECTIONS FROM WEDGES
A. L. Kuhl, R. E. Ferguson, K.-Y. Chien, and P. Collins (Naval Surface Warfare Center, Silver Spring, MD.) 19 Nov. 1991 31 p Presented at the 13th International Colloquium on Dynamics of Explosives and Reactive Systems, Nagoya (Japan), 28 Jul. - 31 Aug. 1991
(Contract W-7405-eng-48)
(DE92-007364; UCRL-JC-107174; CONF-9107160-2) Avail: NTIS HC/MF A03

This paper describes numerical simulations of the unstable wall layer created by the reflection of planar shock waves from wedges. Four cases were considered: a normal shock case, a regular-reflection case, a single-Mach-reflection case, and a double-Mach-reflection case. It was assumed that the wedge contained an initial dense layer, similar to those formed in dusty boundary layers. Shock interactions with the dense layer created vorticity near the wall by the baroclynic mechanism. The wall shear layer was unstable, and rolled up into vortical structures that entrained mass from the fluidized bed. This led to a chaotically striated mixing layer. The flow field was time-averaged in similarity coordinates (i.e., lines of constant r/t and z/t) to establish the mean and fluctuating-flow profiles of the wall layer. Analysis of the results showed that the wall-layer thickness (delta) grew as a power-law function of the distance behind the shock: delta is approximately equal to xi(sup 3/5), and the mass entrainment rate decayed with distance behind the shock m(sub 0) is approximately equal to xi(sup -2/5). DOE

N92-25296* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF RADIATION ON CONVECTION AT MODERATE TEMPERATURES
Henry C. deGroh, III and Mohammad Kassemi (Ohio Aerospace Inst., Brook Park.) 1992 11 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA Previously announced in IAA as A92-27058
(NASA-TM-105632; E-6975; NAS 1.15:105632; AIAA-92-0691)
Copyright Avail: NTIS HC/MF A03

A combined numerical and experimental investigation of radiation-induced convection is presented to show that the convective stability of the top-heated enclosure is disrupted by heat transfer conditions at the wall. When the enclosure is not insulated the thermal stratification of the fluid is modified by convective and radiative losses to the surrounding environment. This results in a double annular cell flow which, when cut by the laser sheet, shows a four-vortex pattern with a weak annular cell at the bottom and a large counter-rotating annular cell at the top. When the enclosure is insulated the convective stability of the fluid is again disrupted - this time as a result of radiative heat transfer between the enclosing surfaces which drives two annular flow cells of relatively equal size. Comparison between model and experiment shows that radiation effects are important even at temperature levels as low as 300 C and, if these effects are not included, numerical predictions can be highly erroneous. Author

N92-25376*# Analytical Services and Materials, Inc., Hampton, VA.
A COMPRESSIBLE NAVIER-STOKES SOLVER WITH TWO-EQUATION AND REYNOLDS STRESS TURBULENCE CLOSURE MODELS Final Report
Joseph H. Morrison Washington NASA May 1992 44 p
(Contract NAS1-19320)
(NASA-CR-4440; NAS 1.26:4440) Avail: NTIS HC/MF A03

This report outlines the development of a general purpose aerodynamic solver for compressible turbulent flows. Turbulent closure is achieved using either two equation or Reynolds stress transportation equations. The applicable equation set consists of Favre-averaged conservation equations for the mass, momentum and total energy, and transport equations for the turbulent stresses and turbulent dissipation rate. In order to develop a scheme with good shock capturing capabilities, good accuracy and general geometric capabilities, a multi-block cell centered finite volume approach is used. Viscous fluxes are discretized using a finite volume representation of a central difference operator and the source terms are treated as an integral over the control volume. The methodology is validated by testing the algorithm on both two and three dimensional flows. Both the two equation and Reynolds stress models are used on a two dimensional 10 degree compression ramp at Mach 3, and the two equation model is used on the three dimensional flow over a cone at angle of attack at Mach 3.5. With the development of this algorithm, it is now possible to compute complex, compressible high speed flow fields using both two equation and Reynolds stress turbulent closure models, with the capability of eventually evaluating their predictive performance. Author

N92-25547 Texas A&M Univ., College Station.
AN EXPERIMENTAL INVESTIGATION OF THE SURFACE FLOW AND WAKE DYNAMICS ASSOCIATED WITH TRANSVERSE FLOW OVER WAVY CYLINDERS Ph.D. Thesis
Byram Bays-Muchmore 1991 311 p
Avail: Univ. Microfilms Order No. DA9206461

Fluid flow over wavy and right circular cylinders was investigated experimentally in the TAMU 2' x 3' wind tunnel and 2' x 3' water tunnel. Surface-pressure and three-component laser-Doppler-velocimetry measurements were obtained at a Reynolds number of 20,000 based on mean diameter. Flow-visualization tests were conducted for right circular cylinders at Reynolds numbers from 330 to 21,000 and for wavy cylinders at Reynolds numbers of 5,000, 10,000 and 20,000. These tests revealed new information concerning the secondary streamwise vortical structures (ribs) in the immediate wake of a right circular cylinder. The formation of the ribs was observed to be linked to an interaction between the near-surface flow on the leeward side of the cylinder and each von Karman vortex as it advected from the vortex-formation region. The spanwise spacing of the ribs in the immediate wake was independent of Reynolds number over the range of Reynolds numbers tested. The ribs significantly affected the von Karman vortices at the upstream end of each braid and rapidly distorted stream surfaces as they were entrained into the wake. The wavy-cylinder flow field exhibited streamwise trailing vortices originating at the boundary-layer separation lines near the geometric nodes. The trailing vortices caused the width of the wake to shrink behind the geometric nodes and expand behind the geometric saddles. The behavior of these structures, in response to the von Karman vortex shedding, indicated that pairing of counter-rotating streamwise vortices can be suppressed by the application of an axial strain field. The wavy-cylinder geometry had no significant effect on the spanwise spacing or the spatial locations of the rib structures. Despite large spanwise variations in the vortex-formation region, the velocity and Reynolds shear-stress fields in the wake of a wavy cylinder rapidly approached a state of spanwise uniformity. No significant differences were observed between the wake of a wavy cylinder and that of a right circular cylinder beyond a distance of 4 diameters downstream. The pressure drag coefficient was not significantly different from that for a right circular cylinder. Dissert. Abstr.

N92-25571 Michigan Univ., Ann Arbor.
NEAR-INJECTOR STRUCTURE OF NON-EVAPORATING PRESSURE-ATOMIZED SPRAYS AT VARIOUS AMBIENT DENSITIES Ph.D. Thesis
Li-Keng Tseng 1991 194 p
Avail: Univ. Microfilms Order No. DA9208673

A theoretical and experimental study of the near-injector region of nonevaporating round liquid jets in still gases is described, emphasizing effects of ambient gas densities in the atomization breakup regime where liquid breakup begins right at the jet exit. Injectors (9.5 mm exit diameter) producing fully developed turbulent pipe flow and slug flow exit conditions were considered. The applicability of the locally homogeneous flow (LHF) approximation to predict flow properties in the near-injector region also was evaluated at various ambient densities. It was found that mixing was strongly affected by the gas/liquid density ratio and the degree of flow development at the jet exit, with the largest gas/liquid density ratio and fully developed turbulent pipe flow yielding the fastest mixing rates. The observed structure of the flow supports the classical view of pressure atomized sprays, e.g., an all liquid core surrounded by a multiphase mixing layer. Dispersed phase properties also are influenced by the gas/liquid density ratio and degree of flow development. Drop sizes and velocities decrease as ambient density increases. Primary breakup was affected by aerodynamic effects at large gas/liquid density ratios while the turbulence intensity in the liquid dominates primary breakup at low gas/liquid density ratios in the near-injector region of the flows. Low liquid volume fractions were found in the multiphase mixing layer suggesting that primary and secondary breakup dominate processes in the mixing layer rather than collisions between smaller drops. Separated flow effects also were evident from large velocity differences between large drops (higher velocities) and small drops (lower velocities), with the velocity differences decreasing as the gas/liquid density ratio increased. Dissert. Abstr.

N92-25577 Minnesota Univ., Minneapolis.
DEVELOPMENT AND EVALUATION OF EFFICIENT SOLUTION PROCEDURES FOR FLUID FLOW AND HEAT TRANSFER PROBLEMS IN COMPLEX GEOMETRIES Ph.D. Thesis
Prabhu Sathyamurthy 1991 346 p
Avail: Univ. Microfilms Order No. DA9130195

Finite-volume solution procedures are developed and evaluated for large-scale fluid flow and heat-transfer problems in complex geometries. A staggered grid arrangement is employed in these methods. A multigrid solution technique is developed to accelerate the convergence of the iterative coupled point-relaxation procedure. The performance of formulations based on the covariant or the contravariant velocity components as the dependent variables in the momentum equations is evaluated. The Cartesian velocity components, extracted from the computed covariant or contravariant velocity fields, are extensively used in the calculation of the source terms due to curvature and secondary diffusion. Two procedures are developed to solve the equations suggested by the two formulations. The first method is the extension of the popular sequential SIMPLER technique to nonorthogonal coordinates. The second method uses a coupled point-relaxation scheme and an adaptive multigrid algorithm. The resulting combinations of formulations and solution procedures are applies to a number of test problems. Dissert. Abstr.

N92-25578 Ohio State Univ., Columbus.
DETAILED DOCUMENTATION OF THE DIRECT EFFECTS OF LARGE EDDY BREAK-UP DEVICES ON THE TURBULENCE STRUCTURE IN TURBULENT BOUNDARY LAYERS Ph.D. Thesis
Nizar Trigui 1991 214 p
Avail: Univ. Microfilms Order No. DA9130574

The direct effect of a single large eddy break up (LEBU) device on the turbulence structure in a turbulent boundary layer was investigated by acquiring detailed three dimensional measurements of all velocity components in the near field of the manipulator. It was found that the incoming large vortical structures are completely suppressed by the LEBU. The suppression of these large scale structures results in a drastic reduction of the entrainment of high speed potential flow. In turn, this results in a reduction of the growth rate of the boundary layer and therefore of the local skin friction, as suggested by the momentum theorem. It was also found that the suppression of these size eddies is attributed to a direct inhibition of the normal component of velocity by the manipulator as they travel over it, and that the streamwise and spanwise fluctuations observed on top of the manipulator downstream of its leading edge are merely passive 'scares' of these incoming large vortical structure, not associated to any significant active transport of momentum. The smaller structures residing lower within the boundary layer were found to be indirectly effected by the overall circulation field around the manipulator. Furthermore, being trapped under the manipulator, these structures are shielded from any interaction with the high speed potential flow, which in turn leads to a weakening of scales on a wider spectrum. Moreover, the wake of the manipulator was found to act as an extension to the manipulator itself to inhibit the normal component of velocity therefore shielding against normal momentum transfer between the structures trapped underneath the manipulator and the outer part of the flow field. This shielding effects is achieved by the localized introduction of small, energetic structures in the wake of the manipulator which are completely uncorrelated with those in the rest of the boundary layer.
Dissert. Abstr.

N92-25619*# Wisconsin Univ., Milwaukee. Dept. of Mechanical Engineering.
PHYSICS OF HEAT PIPE REWETTING Annual Status Report, 1 Apr. 1991 - 31 Mar. 1992

S. H. Chan 31 Mar. 1992 15 p
(Grant NAG9-525)
(NASA-CR-190372; NAS 1.26:190372) Avail: NTIS HC/MF A03

Although several studies have been made to determine the rewetting characteristics of liquid films on heated rods, tubes, and flat plates, no solutions are yet available to describe the rewetting process of a hot plate subjected to a uniform heating. A model is presented to analyze the rewetting process of such plates with and without grooves. Approximate analytical solutions are presented for the prediction of the rewetting velocity and the transient temperature profiles of the plates. It is shown that the present rewetting velocity solution reduces correctly to the existing solution for the rewetting of an initially hot isothermal plate without heating from beneath the plate. Numerical solutions have also been obtained to validate the analytical solutions. Author

N92-25962*# Iowa State Univ. of Science and Technology, Ames. Heat Transfer Lab.
WALL FUNCTIONS FOR THE KAPPA-EPSILON TURBULENCE MODEL IN GENERALIZED NONORTHOGONAL CURVILINEAR COORDINATES Final Report
D. L. Sondak, R. H. Pletcher, and W. R. VanDalsem May 1992 129 p Submitted for publication
(Contracts NCA2-526; NCC2-476; Proj. 3335)
(NASA-CR-190368; NAS 1.26:190368; HTL-55; CFD-25; ISU-ERI-Ames-92259) Avail: NTIS HC/MF A07

A k-epsilon turbulence model suitable for compressible flow, including the new wall function formulation, has been incorporated into an existing compressible Reynolds-averaged Navier-Stokes code, F3D. The low Reynolds number k-epsilon model of Chien (1982) was added for comparison with the present method. A number of features were added to the F3D code including improved far-field boundary conditions and viscous terms in the streamwise direction. A series of computations of increasing complexity was run to test the effectiveness of the new formulation. Flow over a flat plate was computed by using both orthogonal and nonorthogonal grids, and the friction coefficients and velocity profiles compared with a semi-empirical equation. Flow over a body of revolution at zero angle of attack was then computed to test the method's ability to handle flow over a curved surface. Friction coefficients and velocity profiles were compared to test data. All models gave good results on a relatively fine grid, but only the wall function formulation was effective with coarser grids. Finally, in order to demonstrate the method's ability to handle complex flow fields, separated flow over a prolate spheroid at angle of attack was computed, and results were compared to test data. The results were also compared to a k-epsilon model by Kim and Patel (1991), in which one equation model patched in at the wall was employed. Both models gave reasonable solutions, but improvement is required for accurate prediction of friction coefficients in the separated regions. Author

N92-25964*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A HIGH ANGLE OF ATTACK INVISCID SHUTTLE ORBITER COMPUTATION
William L. Kleb and K. James Weilmuenster Apr. 1992 23 p
(NASA-TM-107606; NAS 1.15:107606) Avail: NTIS HC/MF A03

As a preliminary step toward predicting the leeside thermal environment for winged reentry vehicles at flight conditions, a computational solution for the flow about the Shuttle Orbiter at wind tunnel conditions was made using a point-implicit, finite volume scheme known as the Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA). The surface pressures resulting from the computational solution are compared with wind tunnel data. The results indicate that the dominant inviscid flow features are being accurately predicted on the leeside of the Shuttle Orbiter at a moderately high angle of attack. Author

N92-25990# University of Southern California, Los Angeles. Dept. of Mechanical Engineering.
MECHANICS/HEAT-TRANSFER RELATION FOR PARTICULATE MATERIALS
C. S. Campbell, D. G. Wang, and K. Rahman Nov. 1991 60 p
(Contract DE-FG22-88PC-88913)
(DE92-007934; DOE/PC-88913/T10) Avail: NTIS HC/MF A04

The original goal of this study was to try and understand the relationship between the thermal and mechanical properties of particulate flows. Two situations were examined. The first is a study of the effects of simple shear flows, as a embryonic flow type on the apparent thermal conductivity and apparent viscosity of a dry granular flow. The second study involved fluidized beds. The original idea was to try and relate the heat transfer behavior of a fluidized bed to the 'particle pressure,' the forces by only the particle phase of the two-phase mixture. DOE

N92-26019# Cortana Corp., Falls Church, VA.
THE USE OF ADAPTIVE STRUCTURES IN REDUCING DRAG OF UNDERWATER VEHICLES
K. J. Moore, M. Noori, J. Wilson, and J. V. Dugan, Jr. 29 Oct. 1991 5 p
(Contract MDA972-88-C-0064)
(AD-A245316) Avail: NTIS HC/MF A01

Experimental and theoretical studies by researchers in several countries over the last 30 years have shown that the generation of a traveling wave on the surface of a moving body may reduce drag. A laboratory-scale investigation using wave parameters identified in recent CFD studies will further understanding of the physics of traveling wave behavior. Requirements for an active wall test device are discussed in the light of previous experience and new developments in active materials and adaptive structures. GRA

N92-26073# Naval Postgraduate School, Monterey, CA.
NUMERICAL EXPERIMENTS IN UNSTEADY FLOWS THROUGH THE USE OF FULL NAVIER-STOKES EQUATIONS M.S. Thesis
Christopher J. Putzig Jun. 1991 149 p
(AD-A245606) Avail: NTIS HC/MF A07

The numerical simulations of impulsively started flow, non-impulsively started flow, sinusoidally oscillating flow, and, finally, co-existing flow (with mean and oscillatory components) past a circular cylinder have been investigated in great detail through the use of several compact schemes with the Navier-Stokes vorticity/stream function formulation for various Reynolds numbers, frequency parameters, and ambient flow/oscillating flow combinations using VAX-3520 and NASA's supercomputers. Extensive sensitivity analysis has been performed to delineate the effects of time step, outer boundary, nodal points on the cylinder, and the use of higher order polynomials in the calculation of the gradient of wall vorticity. The results have been compared with those obtained experimentally. In many cases the predicted wake region, vorticity and pressure distributions, and the time-variation of the force coefficients have shown excellent agreement with those obtained experimentally. GRA

N92-26094 Nordquist (Bruce O.), Troy, OH.
THE MATHEMATICAL FOUNDATIONS TO NORDQUIST'S THEORY OF TURBULENT TRANSPORT
Bruce O. Nordquist Lost Creek Publishers 1992 42 p
Copyright Avail: Issuing Activity

The creation and substantiation is examined of a highly accurate, closed form mathematical representation of the generation of turbulent transport energy in parallel flow. The concepts are extended of spatial averaging in a time dependent frame in order to preserve the macroscale velocity fluctuations of the basic turbulent flow. The equations developed with these concepts are then shown to furnish mathematical correlations between the general time dependent flow and the mean flow of the Reynolds equations. Within this hierarchy of equations, the originally proposed Reynolds stress relation thereby becomes the mathematical criteria which allows a specific solution of the Reynolds equations to maintain a consistency with the more general equations of motion. From this result, it will therefore follow that within the highly nonlinear structure of turbulent flow, it is neither mathematically consistent nor phenomenologically appropriate to

consider the concept of generating a model for turbulence.
Author

N92-25652# General Motors Corp., Lockport, NY. Harrison Div.
INDUSTRIAL HEAT EXCHANGERS: TYPES AND FUNCTIONS
R. K. Shah *In* VKI, Industrial Heat Exchangers 1991 63 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

N92-25657# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
HEAT TRANSFER ENHANCEMENT FOR SINGLE PHASE FORCED CONVECTION
Martin Fiebig *In* VKI, Industrial Heat Exchangers 1991 71 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

N92-25660# Indiana Univ.-Purdue Univ., Fort Wayne. Dept. of Engineering.
BOILING AND CONDENSATION IN MICROFIN TUBES
Lynn M. Schlager *In* VKI, Industrial Heat Exchangers 1991 28 p (For primary document see N92-25651 16-31)
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N92-25721*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TWO-DIMENSIONAL UNSTRUCTURED TRIANGULAR GRID GENERATION
Philip C. E. Jorgenson *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 85-106 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25722*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CARTESIAN BASED GRID GENERATION/ADAPTIVE MESH REFINEMENT
William J. Coirier *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 107-120 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25727*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTEGRATING AERODYNAMIC SURFACE MODELING FOR COMPUTATIONAL FLUID DYNAMICS WITH COMPUTER AIDED STRUCTURAL ANALYSIS, DESIGN, AND MANUFACTURING
Scott A. Thorp *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 159-168 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25809*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF NEW FLUX SPLITTING SCHEMES
Meng-Sing Liou and Christopher J. Steffen, Jr. *In its* Computational Fluid Dynamics Feb. 1992 p 19-28 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25810*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN ITERATIVE IMPLICIT DDADI ALGORITHM FOR SOLVING THE NAVIER-STOKES EQUATION
S. C. Chen, N. S. Liu, and H. D. Kim *In its* Computational Fluid Dynamics Feb. 1992 p 29-46 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25811*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE PROTEUS NAVIER-STOKES CODE
Charles E. Towne and John R. Schwab *In its* Computational Fluid Dynamics Feb. 1992 p 47-56 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25812*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACCURATE UPWIND-MONOTONE (NONOSCILLATORY) METHODS FOR CONSERVATION LAWS
Hung T. Huynh *In its* Computational Fluid Dynamics Feb. 1992 p 57-64 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUMERICAL SIMULATION OF CONSERVATION LAWS
Chung-Chang Sin and Ming To Wai (Sverdrup Technology, Inc., Cleveland, OH.) *In its* Computational Fluid Dynamics Feb. 1992 p 65-74 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25815*# Sverdrup Technology, Inc., Cleveland, OH.
A TIME-ACCURATE IMPLICIT METHOD FOR CHEMICAL NON-EQUILIBRIUM FLOWS AT ALL SPEEDS
Jian-Shun Shuen *In* NASA. Lewis Research Center, Computational Fluid Dynamics Feb. 1992 p 83-91 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25817*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
UPWIND SCHEMES AND BIFURCATING SOLUTIONS IN REAL GAS COMPUTATIONS
Ambady Suresh (Sverdrup Technology, Inc., Cleveland, OH.) and Meng-Sing Liou *In its* Computational Fluid Dynamics Feb. 1992 p 103-114 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25818*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH ORDER PARALLEL NUMERICAL SCHEMES FOR SOLVING INCOMPRESSIBLE FLOWS
Avi Lin (Pennsylvania Univ., Philadelphia.), Edward J. Milner, May-Fun Liou, and Richard A. Belch *In its* Computational Fluid Dynamics Feb. 1992 p 115-131 Original contains color illustrations (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25819*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EFFICIENT AND ROBUST ALGORITHM FOR TIME DEPENDENT VISCOUS INCOMPRESSIBLE NAVIER-STOKES EQUATIONS
John W. Goodrich *In its* Computational Fluid Dynamics Feb. 1992 p 133-141 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCES IN ENGINEERING TURBULENCE MODELING
T.-H. Shih *In its* Computational Fluid Dynamics Feb. 1992 p 143-161 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25821*# Sverdrup Technology, Inc., Cleveland, OH.
ON RECONTAMINATION AND DIRECTIONAL-BIAS PROBLEMS IN MONTE CARLO SIMULATION OF PDF TURBULENCE MODELS
Andrew T. Hsu *In* NASA. Lewis Research Center, Computational Fluid Dynamics Feb. 1992 p 163-174 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPLEMENTATION OF A KAPPA-EPSILON TURBULENCE MODEL TO RPLUS3D CODE
Tawit Chitsomboon *In its* Computational Fluid Dynamics Feb. 1992 p 175-180 (For primary document see N92-25808 16-07)
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N92-25823*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TURBULENCE AND DETERMINISTIC CHAOS
Robert G. Deissler *In its* Computational Fluid Dynamics Feb. 1992 p 181-192 (For primary document see N92-25808 16-07)
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N92-25824*# Colorado Univ., Boulder.
STABILITY OF COMPRESSIBLE TAYLOR-COUETTE FLOW
K. Kao and C. Chow *In* NASA. Lewis Research Center, Computational Fluid Dynamics Feb. 1992 p 193-203 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25825*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNIQUES FOR ANIMATION OF CFD RESULTS
Jay Horowitz and Jeffery C. Hanson (Sverdrup Technology, Inc., Cleveland, OH.) *In its* Computational Fluid Dynamics Feb. 1992 p 205-217 Original contains color illustrations (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25826*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DISTRIBUTED VISUALIZATION FOR COMPUTATIONAL FLUID DYNAMICS
Don J. Sosoka and Anthony A. Facca *In its* Computational Fluid Dynamics Feb. 1992 p 219-223 Original contains color illustrations (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25827*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNIQUES FOR GRID MANIPULATION AND ADAPTATION
Yung K. Choo, Peter R. Eisemann, and Ki D. Lee (Illinois Univ., Urbana.) *In its* Computational Fluid Dynamics Feb. 1992 p 225-234 (For primary document see N92-25808 16-07)
Avail: NTIS HC/MF A10; 11 functional color pages

N92-25835# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.
CAPILLARY-PUMPED HEAT TRANSPORT SYSTEM TWO-PHASE LOOP AND EVAPORATORS: RESEARCH AND RESULTS
S. VanOost, R. S. Bhatti, M. Dubois, G. Bekaert, and W. Supper (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 77-85 (For primary document see N92-25828 16-18)
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N92-25836# Academy of Sciences (USSR), Svierdlovsk. Inst. of Thermal Physics.
CAPILLARY-PUMP LOOP FOR THE SYSTEMS OF THERMAL REGULATION OF SPACECRAFT
Y. F. Maidanik, Y. G. Fershtater, and K. A. Goncharov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 87-92 Prepared in cooperation with Lavochkin Association, Khimky, USSR (For primary document see N92-25828 16-18)
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N92-25837# MATRA Marconi Space, Toulouse (France).
FIRST RESULTS OF A FREON 12 CAPILLARY PUMPED LOOP
M. Feuillatre, T. Maciaszek, C. Butto, V. Platel, J. Y. Grandpeix, and O. Fudym (Toulouse Univ., France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 93-99 (For primary document see N92-25828 16-18)
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N92-25874# Tsukuba Space Center, Ibaragi (Japan).
ANALYTICAL APPROACH TO MODULATION AND CONTROL OF PUMPED LIQUID LOOPS
Masao Furukawa *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 381-389 (For primary document see N92-25828 16-18)
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N92-25886# Institut fuer Kosmosforschung, Berlin (Germany, F.R.).
ESTIMATION METHODS OF HEAT EXCHANGE PARAMETERS BY TRANSIENTLY MEASURED TEMPERATURES
B. Biering and F. Lura *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 463-466 (For primary document see N92-25828 16-18)
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N92-25897# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
APPLICATION OF CFD TOOLS IN SPACE PROJECTS
E. Embacher and M. Huchler *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 529-535 (For primary document see N92-25828 16-18)
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N92-25905# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.
HIGH CAPACITY GROOVED HEAT PIPES
M. Dubois, S. VanOost, G. Bekaert, and W. Supper (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 575-581 (For primary document see N92-25828 16-18)
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N92-25906# All-Union Research Inst. of Electromechanics, Moscow (USSR).
LIFE TESTS OF ALUMINIUM AXIAL GROOVE HEAT PIPES WITH ACETONE AS A WORKING FLUID
A. D. Lobanov, A. A. Yatsenko, M. D. Parfentiev, and L. V. Barkova *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 583-586 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25907# Joint Research Centre of the European Communities, Petten (Netherlands).
ASSESSMENT OF AN IMPROVED MODEL FOR THE HEAT TRANSFER COEFFICIENT OF GROOVED HEAT PIPE EVAPORATORS
P. C. Stephan and C. A. Busse *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 587-592 (For primary document see N92-25828 16-18)
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N92-25910# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Thermal Control and Life Support Div.
IN-ORBIT DEMONSTRATION OF TWO-PHASE TECHNOLOGY
W. Supper, A. A. M. Delil, and M. Dubois (Societe Anonyme Belge de Constructions Aeronautiques, Brussels.) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 607-612 (For primary document see N92-25828 16-18)
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35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N92-25151# Pittsburgh Univ., PA. Dept. of Physics and Astronomy.
SILICON DRIFT CHAMBER STUDIES FOR THE RHIC STAR EXPERIMENT
T. J. Humanic 24 Feb. 1992 10 p
(Contract DE-FG02-89ER-40503)
(DE92-008732; DOE/ER-40503/3) Avail: NTIS HC/MF A02

The two-hit resolution of a silicon drift chamber is measured using a pulsed Nd:Yag laser and a time digitizer readout. The data is analyzed by forming the covariance matrix in time samples, and transforming to a matrix in amplitude and time variation of each of the two hits. The resolution of the two-hit separation is found to be better than 25 microns with a drift field of 530 V/cm and a separation of more than 500 microns, with the resolution increasing to 50 microns as the separation nears 500 microns. Results are also presented for multiple ionizing tracks, showing a great improvement over single minimum ionizing. DOE

N92-25167# Oak Ridge National Lab., TN.
FIBER-OPTIC SENSOR INTEGRATION AND MULTIPLEXING TECHNIQUES FOR SMART SKIN APPLICATIONS
J. D. Muhs, S. W. Allison, C. J. Janke, S. Kercel, and D. B. Smith 1991 6 p Presented at the Active Materials and Adaptive Structures Conference, Alexandria, VA, 5-7 Nov. 1991
(Contract DE-AC05-84OR-21400)
(DE92-009012; CONF-9111130-2) Avail: NTIS HC/MF A02

Integration and multiplexing techniques for smart skin applications using optical fibers has become an increasingly important topic of research in recent years. This paper reviews the initial stages of research in this area at the Oak Ridge National Laboratory (ORNL). Specifically, results from first generation fiber-optic temperature and strain sensor development efforts are given, along with a discussion of various integration and multiplexing techniques proposed for future development. DOE

N92-25187 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
AN EXPERIMENT IN VDM TO SQL TRANSLATION
Ziad Jabry (Kingston Polytechnic, Kingston-Upon-Thames, England) and Steve Austin Nov. 1991 74 p
(NPL-DITC-193/91; ISSN-0262-5369; ETN-92-91371) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A contribution to showing how the use of formal methods can go beyond specification, and can contribute directly to prototyping and implementation of software is presented. Results of an experiment that illustrates how the formal specification language VDM (Vienna Development Method) can be used to describe a database application, and the feasibility of its direct translation into SPL (Structures Query Language) and implementation in a suitable SQL fourth generation development environment, are given. This translation is concluded to be usable in a suitable prototyping environment before being developed into the final product. The translation of the VDM into SQL is given in full but the actual implementation is not included. ESA

N92-25312# International Atomic Energy Agency, Vienna (Austria).
X RAY AND GAMMA RAY STANDARDS FOR DETECTOR CALIBRATION
Sep. 1991 157 p
(DE92-615125; IAEA-TECDOC-619) Avail: NTIS HC/MF A08

The IAEA established a Coordinated Research Program (CRP) on the measurements and evaluation of x- and gamma-ray standards for detector efficiency calibration in 1986 with the aim of alleviating the generation of such discrepancies. Within the framework of this CRP, representatives of nine research groups from six member states and one international organization performed a number of precise measurements and systematic in-depth evaluations of the required decay data. They have also contributed to the development of evaluation methodology and measurement techniques, and stimulated a number of such studies at laboratories not directly involved in the IAEA project. The results of the work of the CRP, which was finished in 1990, are presented in this report. Recommended values of half-lives and photon emission probabilities are given for a carefully selected set of radionuclides that are suitable for detector efficiency calibration (x-rays from 5 to 90 keV and gamma-rays from 30 to about 3000 keV). Detector efficiency calibration for higher gamma-ray energies (up to 14 MeV) is also considered. The evaluation procedures used to obtain the recommended values and their estimated uncertainties are reported, and a summary of the remaining discrepancies is given. DOE

N92-25314# California Univ., Berkeley. Lawrence Berkeley Lab.
FABRICATION OF SILICON STRIP DETECTORS USING A STEP-AND-REPEAT LITHOGRAPHY SYSTEM
S. Holland Nov. 1991 4 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC03-76SF-00098)
(DE92-008310; LBL-31595; CONF-911106-82) Avail: NTIS HC/MF A01

In this work we describe the use of a step-and-repeat lithography system (stepper) for the fabrication of silicon strip detectors. Although the field size of the stepper is only 20 mm in diameter, we have fabricated much larger detectors by printing a repetitive strip detector pattern in a step-and-repeat fashion. The basic unit cell is 7 mm in length. The stepper employs a laser interferometer for stage placement, and the resulting high precision allows one to accurately place the repetitive patterns on the wafer. A small overlap between the patterns ensures a continuous strip. A detector consisting of 512 strips on a 50 micron pitch has been fabricated using this technique. The dimensions of the detector are 6.3 cm by 2.56 cm. Yields of over 99 percent have been achieved, where yield is defined as the percentage of strips with reverse leakage current below 1 nA. In addition to the inherent advantages of a step-and-repeat system, this technique offers great flexibility in the fabrication of large-area strip detectors since the length and width of the detector can be changed by simply reprogramming the stepper computer. Hence, various geometry strip detectors can be fabricated with only one set of masks, as opposed to a separate set of masks for each geometry as would be required with a contact or proximity aligner. DOE

N92-25351# Department of the Navy, Washington, DC.
FLOWMETER FOR UNSTEADY FLUID FLOW Patent Application
Paul Lefebvre, inventor (to Navy) 19 Dec. 1990 15 p
(AD-D014914; US-Patent-Appl-SN-632872; Navy-Case-72267)
Avail: NTIS HC/MF A03

An electromagnetic flowmeter and a method for measurement of the rate of flow of a fluid under unsteady conditions is described.

It provides a means for adapting steady-state flowmeter technology and a new algorithm to measure transient rate of flow of a fluid such as water. GRA

N92-25454 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
THE UK PRIMARY STANDARD CALORIMETER FOR ABSORBED DOSE MEASUREMENT
A. R. DuSautoy Nov. 1991 37 p
(NPL-RSA(EXT)-25; ISSN-0955-0655; ETN-92-91722) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A description of the mechanical and electrical design, construction and operation of the United Kingdom (UK) primary standard graphite calorimeter system is given. The calorimeter was developed for the measurement of absorbed dose to graphite for high energy photon radiation, 4 to 19 MV, and has become the basis of a therapy level absorbed dose to water calibration service. Absorbed dose to graphite from the photon calorimeter was compared with the dose derived from an ionization chamber and cavity theory for Co-60 gamma radiation, with the dose measured by means of an electron calorimeter for 12 to 14 MeV electrons and with a Co-60 absorbed dose standard. All these comparisons agreed within 0.2, which was within the measurement uncertainties. ESA

N92-25496# Oak Ridge National Lab., TN.
A WIDE-RANGE LOGARITHMIC ELECTROMETER WITH IMPROVED ACCURACY AND TEMPERATURE STABILITY
M. N. Ericson, K. G. Falter, and J. M. Rochelle (Tennessee Univ., Knoxville.) 1992 7 p Presented at the Instrumentation and Measurement Technology Conference, New York, NY, 12-14 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-007253; CONF-920529-1) Avail: NTIS HC/MF A02

The current measurement technique presented in this paper was developed as part of the Atmospheric Radiation Measurement (ARM) Program. A solar radiometer with 38 detector channels was needed for deployment at various outdoor sites for atmospheric studies. Because of the nature of the measurement, 38 preamp channels with 7 decades of input signal range (1 pA to 10 muA) were required. Anticipated ambient temperature variations required that the unit be temperature stable from -18 to 65 C. A 7-decade temperature-compensated logarithmic electrometer is presented. The amplifier is designed for a dynamic range of 1 pA to 10 muA. Temperature compensation is accurately achieved by using an array of four matched monolithic bipolar transistors and straightforward postprocessing techniques. Use of this method results in less than one percent error over the temperature range of -18 to 71 C for 5 decades. In addition, errors resulting from variable forward current emission coefficients of the logarithmic elements are eliminated. In this paper, the problems associated with temperature-compensating logarithmic amplifiers are identified and discussed. Conventional temperature-compensation techniques and associated errors are reviewed. Implementation of the new temperature-compensation technique is fully described and compared with conventional methods. Sources of error are identified, and error minimization procedures are presented. Additional advantages of this new topology relating to calibration and multichannel implementation are discussed. Experimental results and data analysis illustrating the performance of the design are presented. DOE

N92-25608*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A SYSTEM TO MEASURE FLOW MOISTURE CONTENT IN HYPERSONIC WIND TUNNELS
James W. West Apr. 1992 10 p
(NASA-TM-107628; NAS 1.15:107628) Avail: NTIS HC/MF A02

The technique and equipment is described which is used for obtaining data on the moisture content in two NASA Langley Hypersonic Wind Tunnels. A detailed description of the sampling system and its operation is presented along with the moisture analyzer used. The procedure used for converting dew point to parts of water per million by volume (ppmv) is included with graphs that show tunnel moisture content at various pressures. Author

N92-25610*# Arizona Univ., Tucson. Dept. of Electrical and Computer Engineering.
ASSESSMENT OF A PROTOTYPE SUNPHOTOMETER FOR NETWORK APPLICATIONS, PHASE 1 Final Report
J. A. Reagan and John Simpson 22 Aug. 1991 33 p
(Grant NAG5-1712)
(NASA-CR-190126; NAS 1.26:190126) Avail: NTIS HC/MF A03

Data taken in Tucson, AZ, for comparing the CE sunphotometer's results against the Univ. of Arizona's no. 3 solar radiometer are in very good agreement. The spectral voltage intercepts obtained on 15 different days taken with the CE instrument during a seven week period are stable and follow the same daily trends as the voltage intercepts for similar wavelengths contained in the Univ. of Arizona's no. 3 radiometer. The spectral optical depths obtained from both instruments are also in very good agreement and follow the same trends. The only problem that exists in the CE instrument does not have a heater to stabilize the detector temperature which is important around 1000 nm. Zenith sky radiance scans are in good agreement, but both instruments are biased by direct solar rays entering the instrument's respective entrance apertures. All diffuse light data shown were, therefore, taken with the instruments shielded from the direct sun. The CE sunphotometer results pertaining to the water vapor wavelength's are also in good agreement with the Univ. of Arizona's no. 3 and should prove useful for water vapor retrieval. Author

N92-26137# Analysis and Measurement Services Corp., Knoxville, TN.
NEW TECHNOLOGY FOR REMOTE TESTING OF RESPONSE TIME OF INSTALLED THERMOCOUPLES. VOLUME 1: BACKGROUND AND GENERAL DETAILS Final Report, Sep. 1987 - Dec. 1990
H. M. Hashemian Jan. 1992 233 p
(Contract F40600-87-C-0003)
(AD-A245591; AEDC-TR-91-26-Vol-1) Avail: NTIS HC/MF A11

A comprehensive research and development project was completed to provide new technology for remote testing of response time of thermocouples as installed in operating processes. A significant portion of this development depended on the Loop Current Step Response (LCSR) method. This method is based on heating the thermocouple internally by applying an electric current to its extension leads. The current produces Joule heating in the thermocouple and causes the thermocouple junction to settle several degrees above the ambient temperature. The current is then cut off and the thermocouple output is recorded as it cools to the ambient temperature. It has been established by experimental research and theoretical development carried out in this project that this cooling transient can be analyzed to provide the response time of the thermocouple under the conditions tested. With little additional effort, the equipment that was developed in this project can be adapted to provide a capability for in-situ assessment of static health, reliability, and accuracy of installed thermocouples. GRA

N92-26141# California Univ., Berkeley.
THE MTX COMPUTER CONTROL SYSTEM FOR THE 400 KILOWATT 140 GHz GYROTRON
M. C. Jackson, S. W. Ferguson, and D. E. Petersen Sep. 1991 7 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-009694; UCRL-JC-107247; CONF-910968-78) Avail: NTIS HC/MF A02

A 400 kilowatt, 140 GHz gyrotron is employed on MTX as a source of direct plasma heating and, additionally, as a driver for a free electron laser, which is used for plasma heating. The control system that operates this gyrotron uses a new graphics oriented software system called TACL (Thaumaturgic Automated Control Logic) developed by the Continuous Electron Beam Accelerator

Facility (CEBAF) and owned by DOE. This control language does not require a software specialist, but is easily handled by the engineer or technician working on the system. All control logic and custom displays are entered via graphics oriented editors and no actual lines of code need to be written. The graphics displays make the gyrotron operation quite simple and allow individual users to define displays to meet their own needs or develop one for a specific set of tests to be run. The system, additionally, can be used for logging functions, which have been found quite useful in tracking long term trends in vacion current and calorimetry of gyrotron cooling circuits. The system is composed of one computer (HP 9000 series 300) controlling multiple CAMAC crates located at the various components used in the system. A second series 300 computer is used as a supervisor and is located in the main tokamak control room. This supervisory computer provides remote operation of the gyrotron, and also provides a link to the microwave transport vacuum control (also TACL). The supervisory computer, additionally, is used as a subsystem status summary point for permissives to the gyrotron control system. DOE

N92-26163# Lawrence Livermore National Lab., CA.
A MODULAR TIMING SYSTEM FOR MEGAWATT GYROTRONS
D. E. Petersen Sep. 1991 6 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-009465; UCRL-JC-107248; CONF-910968-75) Avail: NTIS HC/MF A02

A new timing system has been designed to meet the requirements for the one megawatt test set (MWTS). This test set is a system of power supplies, support systems, controls, and monitors that will be used for the development of one megawatt gyrotrons at the microwave tube division of Varian in Palo Alto, CA. The purpose of the timing system is to provide timing signals for control of the gyrotron's cathode, anode, and heater power supplies as well as oscilloscope, digitizer, and other control or diagnostic triggers. Some unique timing requirements include four main operating modes: single pulse, repetitive pulse, continuous (CW), and CW cathode with repetitively pulsed anode. Timing adjustments (i.e., delays, durations, and rep rates) can be made while the tube is running with no adverse effects. This modular, distributed timing system is implemented using two LLNL designed CAMAC modules: the Master Timing Controller and the Two Channel Timing Generator. A single master timing controller provides real-time control and synchronization for all timing generators in the system. The timing generators provide triggers having adjustable delay and duration to the various system components. This paper will concentrate on the functions and features of the timing system. DOE

N92-25602# Deutsche System-Technik G.m.b.H., Bremen (Germany, F.R.).
TESTING OF AN EXPERIMENTAL PHOTOGRAPHIC RECONNAISSANCE SYSTEM [ERPROBUNG EINES EXPERIMENTALSYSTEMS ZUR BILDAUFKLAERUNG]
H. Keil and P. Schulz (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) *In* DLR, Flight Test of Avionic and Air-Traffic Control Systems Jul. 1991 p 233-246 In GERMAN (For primary document see N92-25590 16-04)
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutche marks

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N92-25159# Colorado Univ., Boulder. Dept. of Chemistry and Biochemistry.
LASER PHOTOELECTRON SPECTROSCOPY OF IONS
G. B. Ellison 16 Jan. 1992 11 p
(Contract DE-FG02-87ER-13695)
(DE92-010012; DOE/ER-13695/3) Avail: NTIS HC/MF A03

This enterprise uses photoelectron spectroscopy to study the properties of negative ions and radicals. The essence of our experiment is to cross a 0.6 keV mass-selected ion beam (M(sup -)) with the output of a CW laser, (Dirac h)omega(sub o). The resultant detached photoelectrons with kinetic energy, KE, are energy analyzed by means of a set of electrostatic hemispherical analyzers. Analysis of the photoelectron spectra enables us to extract molecular electron affinities, vibrational frequencies and electronic splittings of the final radical, M, as well as the relative molecular geometries of ions (M(sup -)) and radicals (M). We have scrutinized the two simplest nitrenes: methylnitrene (CH3N) and phenylnitrene (C6H5N). By preparing the corresponding anions, CH3N(-) and C6H5N(-), we have studied these nitrene biradicals. Singlet methylnitrene is especially interesting since it is formally a 'transition state'. DOE

N92-25219# Lawrence Livermore National Lab., CA.
PRELIMINARY CUTTING AND DRILLING STUDIES USING NEW GENERATION LASERS
D. D. Kautz, J. S. Sze, E. P. Dragon, and R. S. Hargrove 20 Feb. 1992 5 p Presented at the 8th Conference on State-of-the-Art Electron Beam Melting and Refining, Reno, NV, 13-15 Nov. 1991
(Contract W-7405-eng-48)
(DE92-009681; UCRL-JC-109918; CONF-911189-4) Avail: NTIS HC/MF A01

High power and radiance dye lasers developed at Lawrence Livermore National Laboratory show promise for material processing tanks. Evaluation using welding heat flow models suggest significant increases in precision and speed are expected. We developed tooling and instrumentation to diagnose important parameters including spot geometry and optical train quality. We started processing studies to determine the viability of these lasers of cutting and drilling. We used titanium alloys first in the studies due to the availability of comparable parametric studies in the technical literature. Results show that cuts and holes with extremely fine features can be made with dye lasers. The high radiance beam produces low distortion and small heat-affected zones. We have accomplished very high aspect ratios and micron scale kerfs and holes. Through continued system improvement and process optimization, we believe that submicron levels will be achieved. DOE

N92-25492*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A PARAMETRIC STUDY OF AN EXCIMER PUMPED RAMAN SHIFTER FOR LIDAR APPLICATIONS
S. E. Bisson, J. E. M. Goldsmith, M. Lapp (Sandia National Labs., Albuquerque, NM.), D. N. Whiteman, R. A. Ferrare, and S. H. Melfi 1991 4 p Presented at the CLEO/QELS '92, Anaheim, CA, 10-17 May 1992
(Contract DE-AC04-76DR-00789)
(NASA-TM-107821; NAS 1.15:107821; DE92-006702; SAND-91-8750; CONF-920573-3) Avail: NTIS HC/MF A01

High average power ultraviolet (UV) laser sources are needed for many remote sensing applications such as Raman, fluorescence, and differential absorption lidars. We are currently developing an excimer-pumped, wavelength flexible Raman shifter for lidar applications. DOE

N92-25520# Swedish Inst. for Materials Testing, Boras.
LEAST-SQUARES CALCULATION OF LASER FREQUENCY DIFFERENCES
L. R. Pendrill and U. Kaern 1991 23 p
(PB92-152297; SP-RAPP-1991:52; ISBN-91-7848-310-7) Avail: NTIS HC/MF A03

A practical realization of the unit of length with frequency stabilized lasers often involves values of frequency shifts deduced from comparative frequency difference measurements between several lasers. The application of the method of least squares to

series of frequency difference measurements between a pair of lasers, each of which may be stabilized in frequency to one of several iodine saturated absorption spectral components, is reviewed. A comparison is made between different approaches in formalism. Also, some more thought is given to the estimation of uncertainties in the deduced frequency shifts of each laser.
Author

N92-25576 City Univ. of New York, NY.
CONTINUOUS WAVE ENERGY TRANSFER DYE LASERS IN THE NEAR INFRARED SPECTRAL REGION: THEORY, MODELING, SIMULATION, PERFORMANCE Ph.D. Thesis
Basilios Panoutsopoulos 1991 150 p
Avail: Univ. Microfilms Order No. DA9130359

Energy transfer processes in dye mixture lasers in which optical excitation energy is absorbed by one dye (the donor) and transferred to a second dye (the acceptor) in which laser action takes place, have been extensively studied to improve the efficiency and broaden the attainable spectral range of pulsed dye lasers. We developed a theoretical simulation model which predicts the attainable gain spectrum of CW laser pumped energy transfer dye lasers (ETDL) as a function of donor and acceptor concentrations, their spectral parameters, energy transfer parameters, laser cavity, and pumped power and excitation wavelength. The model takes into account contributions due to both radiative and nonradiative energy transfer. Numerical simulation results applied the model to different dyes. The model predicts that there are a number of useful dye candidate pairs that would benefit from the ETDL approach in terms of reduced power and attainable spectral range. Analysis of the relevant gain parameters of CW EDTL's, together with results for a representative and practically useful donor-acceptor pair, is presented. We used the argon ion laser to excite an ETDL with Rhodamine 610 as donor and Nile Blue 690 as acceptor to demonstrate laser action in the near infrared, with operational parameters very close to those predicted by our theoretical simulation model. It is believed that the results obtained in this work open up a new and practically useful avenue for CW laser operation with improved spectral capabilities and reduced pump requirement. Dissert. Abstr.

N92-25746# Lawrence Livermore National Lab., CA.
FOUR-HARMONIC DATABASE OF LASER-DAMAGE TESTING
F. Rainer, L. J. Atherton, J. H. Campbell, F. P. DeMarco, M. R. Kozlowski, A. J. Morgan, and M. C. Staggs 27 Dec. 1991 12 p Presented at the SPIE International Society for Optical Engineering Meeting, Boulder, CO, 23-25 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008072; UCRL-JC-108275; CONF-911064-5) Avail: NTIS HC/MF A03

In the past two years we have made a sixfold expansion of our laser-damage database. Our primary emphasis has been with the fundamental 1064 nm irradiation generated by Nd:YAG. Because of the increasing need for high-threshold optics designed to operate in the UV, we include data covering the harmonics at 532, 355 and 266 nm. This is further supplemented with results of excimer laser damage testing at 351 and 248 nm. The presented summaries cover over eight years of complete data plus selected results spanning over a fourteen-year history of damage testing at LLNL using thirteen different laser systems. Besides the range of wavelengths, our parameter space covers pulse durations from less than 1 to 84 ns, repetition rates from single shots to 6000 Hz, and irradiation modes from single shots to a variety of multiple-shot laser-conditioning techniques. DOE

N92-26024# Stanford Linear Accelerator Center, CA.
HIGH RESOLUTION FRESNEL ZONE PLATE LASER ALIGNMENT SYSTEM
V. E. Bressler, G. E. Fischer, R. E. Ruland, and T. Wang Mar. 1992 4 p Presented at the 3rd European Particle Accelerator Conference, Berlin, Germany, 24-28 Mar. 1992
(Contract DE-AC03-76SF-00515)
(DE92-010747; SU-SLAC-PUB-5765; CONF-920315-9) Avail: NTIS HC/MF A01

The existing Fresnel zone plate laser alignment system is currently being extended and upgraded for the Final Focus Test Beam (FFTB). Previously, the resolution of this system has been several tens of micrometers. After the upgrade, the resolution will be a few micrometers. Details of the upgrade as well as simulation and experimental results are presented. DOE

N92-26080# Naval Postgraduate School, Monterey, CA.
HIGH-GAIN, HIGH-POWER FREE ELECTRON LASERS M.S. Thesis
Jung-Hyun Park Jun. 1991 41 p
(AD-A245876) Avail: NTIS HC/MF A03

The Paladin FEL experiment is shown to exhibit clear and dramatic effects governed by the electron beam velocity distribution for the first time. The FEL integral equation is used to show that there is significant broadening of the gain spectrum due to the Gaussian velocity distribution, and also shows a plateau in the gain evolution along the undulator due to a triangular-shaped velocity distribution. The gain spectra and power evolution from simple, single-mode simulations are compared to the ELF experiments. The microwave power evolution along the undulator is compared as well for both the tapered and untapered undulators. In all cases, the agreement is found to be good. GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-25255*# Alabama Univ., Huntsville. Center for Applied Optics.
WELDING SPACE VACUUM TECHNOLOGY Final Report, Oct. 1990 - Sep. 1991
R. Barry Johnson Dec. 1991 8 p
(Contract NAS8-36955)
(NASA-CR-184318; NAS 1.26:184318) Avail: NTIS HC/MF A02

The objective was to assist the EH 42 Division in putting together a vacuum system that could attain the desired pressure and be large enough to accommodate the gas-metal arc (GMA) welding fixture apparatus. A major accomplishment was the design and fabrication of the controller/annunciator for the 4' by 8' system. It contains many safety features such as thermocouple set point relays that will only allow inlet and exit gas and vacuum valves to be operated at pre-selected system pressures, and a fail safe mode for power interruptions and operator mistakes. It is felt that significant progress was made in this research effort to weld in a vacuum environment. With continued efforts to increase the pump speeds for vacuum chambers and further studies on weld fixtures and gas inlet pressures, the NASA program will be successful.
Author

N92-25316# Sandia National Labs., Albuquerque, NM.
LINEARIZING THE JOINT TORQUE CHARACTERISTICS OF AN ELECTRIC DIRECT-DRIVE ROBOT FOR HIGH PERFORMANCE CONTROL OF IN-CONTACT OPERATIONS
P. F. Muir 1992 27 p Presented at the IEEE International Conference on Robotics and Automation, Nice, France, 10-15 May 1992
(Contract DE-AC04-76DP-00789)
(DE91-018799; SAND-91-1669C; CONF-920540-3) Avail: NTIS HC/MF A03

Many robot control algorithms for high performance in-contact operations including hybrid force/position, stiffness control, and impedance control approaches require the command of the joint torques. However, most commercially available robots do not provide joint torque command capabilities. The joint command at the user level is typically position or velocity and at the control developer level is voltage current, or pulse-width, and the torque generated is a nonlinear function of the command and joint position. To enable the application of high performance in-contact control algorithms to commercially available robots, and thereby facilitate technology transfer from the robot control research community to

commercial applications, a practical methodology has been developed to linearize the torque characteristics of electric motor-amplifier combinations. A four degree-of-freedom Adept 2 robot, having pulse-width modulation amplifiers and both variable reluctance and brushless DC motors, is converted to operate from joint torque commands to demonstrate the methodology. The average percentage torque deviation over the command and position ranges is reduced from as much as 76 percent to below 5 percent for the direct-drive joints 1, 2, and 4 and is cut by one half in the remaining ball-screw driven joint 3. DOE

N92-25342# National Aerospace Lab., Tokyo (Japan).
TURBINE DRIVE SYSTEM OF THE HIGH PRESSURE LOX TURBOPUMP TEST FACILITY
Y. Watanabe, S. Hasegawa, K. Kamijo, R. Hashimoto, Y. Sakamoto, and S. Tone Jan. 1991 17 p In JAPANESE; ENGLISH summary
(DE92-783191; NAL-TM-631) Avail: NTIS HC/MF A03

This paper describes the turbine drive system of facilities such as a gas generator among high pressure liquid oxygen (LOX) turbopump test facilities, which were constructed for the rating test of a high pressure LOX turbopump. In particular, the control sequence of the high pressure gaseous hydrogen/liquid oxygen gas generator and the turbine exhaust gas disposal unit for high pressures and large flows are explained in detail. The gas generator requires a large amount of propellant. Therefore control valves or remote control valves, which can accurately control and supply large and small amounts of propellant, are needed. As a result, a programmable sequencer was developed in order to control the opening and closing of every valve. Moreover, as a solution to the problem of aerodynamic noise and oscillation, a method to install a pressure reducing unit in the exhaust gas disposal system was applied. As a result, it was possible to discharge a large quantity of high temperature and high pressure combustion gas with excess hydrogen after driving the turbine without excessive noise and oscillation. DOE

N92-25347*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARISON BETWEEN THEORETICAL PREDICTION AND EXPERIMENTAL MEASUREMENT OF THE DYNAMIC BEHAVIOR OF SPUR GEARS
Brian Rebbechi, B. David Forrester (Materials Research Labs., Melbourne, Australia), Fred B. Oswald, and Dennis P. Townsend 1992 10 p Proposed for presentation at the Sixth International Power Transmission and Gear Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME
(NASA-TM-105362; E-6953; NAS 1.15:105362;
AVSCOM-TR-91-C-009) Avail: NTIS HC/MF A02

A comparison was made between computer model predictions of gear dynamics behavior and experimental results. The experimental data were derived from the NASA gear noise rig, which was used to record dynamic tooth loads and vibration. The experimental results were compared with predictions from the DSTO Aeronautical Research Laboratory's gear dynamics code for a matrix of 28 load speed points. At high torque the peak dynamic load predictions agree with the experimental results with an average error of 5 percent in the speed range 800 to 6000 rpm. Tooth separation (or bounce), which was observed in the experimental data for light torque, high speed conditions, was simulated by the computer model. The model was also successful in simulating the degree of load sharing between gear teeth in the multiple tooth contact region. Author

N92-25396*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPARISON OF ANALYSIS AND EXPERIMENT FOR GEARBOX NOISE
Fred B. Oswald, A. F. Seybert, T. W. Wu, and William Atherton (Cleveland State Univ., OH.) 1992 7 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME and Journal of Mechanical Design
(NASA-TM-105330; E-6696; NAS 1.15:105330;
AVSCOM-TR-91-C-030) Avail: NTIS HC/MF A02

Low contact ratio spur gears were tested in the NASA gear-noise rig to study the noise radiated from the top of the gearbox. Experimental results were compared with a NASA acoustics code to validate the code for predicting transmission noise. The analytical code is based on the boundary element method (BEM) which models the gearbox top as a plate in an infinite baffle. Narrow band vibration spectra measured at 63 nodes on the gearbox top were used to produce input data for the BEM model. The BEM code predicted the total sound power based on the measured vibration. The measured sound power was obtained from an acoustic intensity scan taken near the surface of the gearbox at the same 63 nodes used for vibration measurement. Analytical and experimental results were compared at four different speeds for sound power at each of the narrow band frequencies over the range of 400 to 3200 Hz. Results are also compared for the sound power level at meshing frequency plus three sideband pairs and at selected gearbox resonant frequencies. The difference between predicted and measure sound power is typically less than 3 dB with the predicted value generally less than the measured value. Author

N92-25447*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF CONTACT RATIO ON SPUR GEAR DYNAMIC LOAD
Chuen-Huei Liou, Hsiang Hsi Lin, Fred B. Oswald, and Dennis P. Townsend 1992 7 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105606; E-6942; NAS 1.15:105606;
AVSCOM-TR-91-C-025) Avail: NTIS HC/MF A02

A computer simulation is presented which shows how the gear contact ratio affects the dynamic load on a spur gear transmission. The contact ratio can be affected by the tooth addendum, the pressure angle, the tooth size (diametral pitch), and the center distance. The analysis presented was performed using the NASA gear dynamics code, DANST. In the analysis, the contact ratio was varied over the range 1.20 to 2.40 by changing the length of the tooth addendum. In order to simplify the analysis, other parameters related to contact ratio were held constant. The contact ratio was found to have a significant influence on gear dynamics. Over a wide range of operating speeds, a contact ratio close to 2.0 minimized dynamic load. For low contact ratio gears (contact ratio less than 2.0), increasing the contact ratio reduced the gear dynamic load. For high contact ratio gears (contact ratio = or greater than 2.0), the selection of contact ratio should take into consideration the intended operating speeds. In general, high contact ratio gears minimized dynamic load better than low contact ratio gears. Author

N92-25448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MINIMIZATION OF THE VIBRATION ENERGY OF THIN-PLATE STRUCTURE
Katsumi Inoue, Dennis P. Townsend, and John J. Coy 1992 10 p Proposed for presentation at the 1992 Design Automation Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105654; E-6623; NAS 1.15:105654;
AVSCOM-TR-91-C-028) Avail: NTIS HC/MF A02

An optimization method is proposed to reduce the vibration of thin plate structures. The method is based on a finite element shell analysis, a modal analysis, and a structural optimization method. In the finite element analysis, a triangular shell element with 18 dof is used. In the optimization, the overall vibration energy of the structure is adopted as the objective function, and it is minimized at the given exciting frequency by varying the thickness of the elements. The technique of modal analysis is used to derive the sensitivity of the vibration energy with respect to the design

variables. The sensitivity is represented by the sensitivities of both eigenvalues and eigenvectors. The optimum value is computed by the gradient projection method and a unidimensional search procedure under the constraint condition of constant weight. A computer code, based on the proposed method, is developed and is applied to design problems using a beam and a plate as test cases. It is confirmed that the vibration energy is reduced at the given exciting frequency. For the beam excited by a frequency slightly less than the fundamental natural frequency, the optimized shape is close to the beam of uniform strength. Author

N92-25468# Argonne National Lab., IL.
THE 1991 NATURAL GAS VEHICLE CHALLENGE: DEVELOPING DEDICATED NATURAL GAS VEHICLE TECHNOLOGY
R. Larsen, W. Rimkus, J. Davies, M. Zammit, and P. Patterson 1992 56 p Presented at the 1992 Society of Automotive Engineers (SAE) International Congress and Exposition, Detroit, MI, 24-28 Feb. 1992
(Contract W-31-109-eng-38)
(DE92-007371; ANL/CP-75223; CONF-920233-3) Avail: NTIS HC/MF A04

An engineering research and design competition to develop and demonstrate dedicated natural gas-powered light-duty trucks, the Natural Gas Vehicle (NGV) Challenge, was held June 6-11, 1991, in Oklahoma. Sponsored by the US Department of Energy (DOE), Energy, Mines, and Resources -- Canada (EMR), the Society of Automative Engineers (SAE), and General Motors Corporation (GM), the competition consisted of rigorous vehicle testing of exhaust emissions, fuel economy, performance parameters, and vehicle design. Using Sierra 2500 pickup trucks donated by GM, 24 teams of college and university engineers from the US and Canada participated in the event. A gasoline-powered control was included in the performance testing as a reference vehicle. This paper discusses the results of the event, summarizes the technologies employed, and makes observations on the state of natural gas vehicle technology. DOE

N92-25505# Mechanical Technology, Inc., Latham, NY.
POWDER-LUBRICATED PISTON RING DEVELOPMENT
H. Heshmat Jun. 1991 137 p
(Contract DE-AC21-88MC-25252)
(DE91-016655; DOE/MC-25252/3024) Avail: NTIS HC/MF A07

The overall objective of this program was to demonstrate the feasibility of a new particulate lubrication concept for reducing piston ring/cylinder liner wear in coal-water slurry-fueled diesels by replacing the present oil-lubricated system with powder lubrication that would utilize coal ash, either alone or in combination with another powder. The feasibility of this particular lubrication concept for reducing ring/liner wear was demonstrated in a series of experiments utilizing redesigned and properly selected components. Wear performance for suitable ring/liner materials lubricated with a powder that incorporates the abrasive ash particles was evaluated in terms of load capacity, friction, and rate of wear for the best combination of ring design, ring and liner materials, and powder constituents. In addition, the use of a powder-lubricated system in the upper portion of the cylinder isolated the particulates from the lower portions of the engine, thus further reducing engine wear. DOE

N92-25556 New Mexico Univ., Albuquerque.
ELASTIC DEFORMATION CHARACTERISTICS AND CONSTITUTIVE EQUATIONS OF LIGHT WEIGHT FLEXIBLE ROBOT MANIPULATORS Ph.D. Thesis
Ali Meghdari 1987 175 p
Avail: Univ. Microfilms Order No. DA9207353

Theoretical techniques have been developed to determine the tip positional errors of statically loaded flexible manipulators for any position and orientation. Two different approaches were taken in the analysis of flexible components of manipulator arms. One of which employs the strain energy invariance principle with respect to the elemental and the system reference coordinate frames in conjunction with the differential equations used in the classical beam theory to derive the desired combined flexural-joint stiffness matrix of the robotic structure. The second approach takes advantage of the (4 by 4) Denavit-Hartenberg homogeneous transformations to describe the kinematics of light weight flexible robotic arms under static loading. These methods are general in the sense that they may be applied to n-axis flexible manipulator arms. However, to simplify the derivations without deteriorating the techniques, only models of two link manipulator arms with flexible members are considered. To verify performance, these methods are simulated on an 11/780 Vax computer. Furthermore, sample of a two link motor arm were designed and constructed where the comparison between experimental and the theoretical results is quite satisfactory. The deformational inaccuracies of a current (so called rigid) manipulator such as the PUMA 560 robot is also examined and definite elastic deformation trends have been observed and discussed. Dissert. Abstr.

N92-25649*# Detroit Diesel Allison, Indianapolis, IN.
ADVANCED TURBINE TECHNOLOGY APPLICATIONS PROJECT (ATTAP) Final Annual Report, 1990
Dec. 1991 156 p
(Contract DEN3-336)
(NASA-CR-189142; DOE/NASA/0336-3; NAS 1.26:189142; EDR-15593) Avail: NTIS HC/MF A08

ATTAP activities were highlighted by test bed engine design and development activities; ceramic component design; materials and engine component characterization; ceramic component process development and fabrication; component rig testing; and test bed engine fabrication and testing. Specifically, ATTAP aims to develop and demonstrate the technology of structural ceramics that have the potential for competitive automotive engine life cycle cost and for operating for 3500 hours in a turbine engine environment at temperatures up to 1371 C (2500 F). Author

N92-25748# Lawrence Livermore National Lab., CA.
A LIGHTWEIGHT PUMPED HYDRAZINE ORBIT MANEUVERING SPACE VEHICLE
J. C. Whitehead 31 Jan. 1992 8 p Presented at the 1992 Joint Army, Navy, NASA, Air Force (JANNAF) Propulsion Meeting, Indianapolis, IN, 24-27 Feb. 1992
(Contract W-7405-eng-48)
(DE92-008239; UCRL-JC-109568; CONF-920273-1) Avail: NTIS HC/MF A02

An orbital maneuvering vehicle has a pair of opposed cylindrical piston tanks for hydrazine, and four transverse liquid rocket engines along a longitudinal plane. A new kind of pumped rocket propulsion provides maneuvering thrust on demand, and free-piston pumps which can rapidly start and stop are radially oriented between thrusters. A major advantage of this configuration is that the tanks can be close together, which maximizes the vehicle's longitudinal bending stiffness while minimizing the mass of the central bridging structure. The impulses from pump exhaust and piston reciprocation are directed through the system mass center, so they apply no disturbance torques. All high-temperature components are located on the outside of the central structure, where they are free to expand and radiate heat without detrimental effects. Virtually all lightweight components have been fabricated and tested, and photographs of hardware subassemblies are presented. DOE

N92-25755# Southwest Research Inst., San Antonio, TX. Engine, Fuel, and Vehicle Research Div.
WEAR MECHANISM AND WEAR PREVENTION IN COAL-FUELED DIESEL ENGINES
J. A. Schwalb Jun. 1991 49 p
(Contract DE-AC21-89MC-26044)
(DE92-001123; DOE/MC-26044/3048) Avail: NTIS HC/MF A03

Contamination of the lube-oil with hard abrasive particles leads to a three-body abrasive wear mechanism that highly accelerates piston ring/cylinder liner wear in coal-fueled diesel engines. One approach to reducing that wear is to modify the size and orientation of surface asperities on the cylinder to enhance the formation of a hydrodynamic film, and to provide avenues of escape for particles that would otherwise be trapped in the wear zone. Another

approach is to introduce additives into the contaminated lube-oil that further enhance hydrodynamic film formation, form chemical films on the wearing surfaces, or form films on the contaminant particles. This work focuses on defining the effects of cylinder liner surface finish, various configurations of slots in the cylinder liner surface, and various additives in the contaminated lube-oil on the wear process. Wear tests were initiated in a bench apparatus using coal-ash contaminated lube-oil to test the various wear configurations. The results of these tests indicate that the formation of a hydrodynamic film between the ring and cylinder specimens is enhanced by increasing surface roughness, and by orienting the surface asperities normal to the direction of ring travel but modifications to the cylinder liner surface did not greatly reduce the wear rate. Additives to the lubricant seemed to have a much more significant effect on wear, with a dispersant additive highly accelerating the wear, while a detergent additive was able to reduce the wear almost to the rate achieved where there was no contaminant. DOE

N92-25801# Naval Postgraduate School, Monterey, CA.
MODELLING EXPERIMENTAL PROCEDURES FOR MANIPULATOR CALIBRATION M.S. Thesis
William E. Swayze Dec. 1991 211 p
(AD-A245603) Avail: NTIS HC/MF A10

A six degree of freedom manipulator, a PUMA 560, is calibrated using three different measurement systems in order to improve the accuracy of the manipulator. Closed loop kinematic chain modeling theory is presented. Variations in the models for each calibration method are presented. A simulation study is conducted to determine feasibility of the proposed methods. Experimental data is obtained and the actual calibration performed. A comparative analysis between both simulation and experiment and between measurement systems is performed. Various aspects regarding measurement system modeling are discussed. The calibrated kinematic parameters are presented as results. GRA

N92-25807# Allied-Signal Aerospace Co., Kansas City, MO.
RESISTANCE SEAM WELDING
D. L. Hollar, Jr. Mar. 1992 33 p
(Contract DE-AC04-76DP-00613)
(DE92-010072; KCP-613-4702) Avail: NTIS HC/MF A03

Considerable insight and understanding were achieved in regard to the influence of all of the weld parameters on the seam weld processes at Allied-Signal Inc., Kansas City Division (KCD). Several mechanical improvements were made in the seam weld equipment. The electrode design was modified to include glass bead blasting of the periphery. This greatly improved the electrode performance consistency. Also, the new electrode design defined a refurbishing process that allowed the electrodes to be used up to three times. Originally, the electrodes were discarded after one use. A substantial cost savings resulted form this improvement. A 0 to 1500 ampere current transformer was inserted in the weld circuit to monitor weld current during the weld as an additional process control element. The transformer is also used to calibrate the weld power supply. A monocular microscope with a cross hair reticle was added to allow more precise electrode alignment. Other improvements included increased brush spring force and the addition of a 5 to 1 gear reduction on the electrode drive motor. DOE

N92-26020# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
AUTOMATED HANDLING AND ASSEMBLING OF NON-RIGID OBJECTS Semiannual Report No. 4, 16 Jul. 1991 - 15 Jan. 1992
Yuan F. Zheng 15 Jan. 1992 71 p
(Contract N00014-90-J-1516)
(AD-A245321) Avail: NTIS HC/MF A04

The objective of this research project is to identify mechanisms for automated handling and assembling of non-rigid objects. To accomplish the goal, four aspects of the problem have been identified in our original proposal: (1) the study of the deformation characteristics of non-rigid materials; (2) the investigation of optimal tool structure for handling non-rigid objects; (3) the development of the sensing mechanism to locate non-rigid objects; and (4) the development of the motion control mechanism for the host machines. To study the above four aspects, many technical issues need to be studied. In the past six months, three topics were studied. The first topic investigates the method for measuring a deformed surface using laser displacement sensors installed on articulated coordinate measuring machines (CMM). This second topic addresses a new method hand/eye calibration. The third topic studies the virtual space problem of deformed objects. GRA

N92-26106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF LUBRICANT JET LOCATION ON SPIRAL BEVEL GEAR OPERATING TEMPERATURES
Robert F. Handschuh 1992 10 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105656; E-7020; NAS 1.15:105656;
AVSCOM-TR-91-C-033) Avail: NTIS HC/MF A02

An experimental study was conducted to determine the effect of lubricant jet location on spiral bevel gear bulk temperatures. Transient surface temperatures were also measured. Tests were conducted on aircraft quality spiral bevel gears in a closed loop test facility. Thermocoupled pinions and an infrared microscope were used to collect the pertinent data. A single fan jet lubricated the test gears. Lubricant flow rate (lubricant jet pressure) and applied torque were also varied. The results showed that jet placement had a significant effect on the gear bulk temperatures. Author

N92-26107*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF OPERATING CONDITIONS ON GEARBOX NOISE
Fred B. Oswald, James J. Zakrajsek, Dennis P. Townsend, William Atherton, and Hsiang Hsi Lin (Memphis State Univ., TN.) 1992 8 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Phoenix, AZ, 13-16 Sep. 1992; sponsored by ASME
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105331; E-6732; NAS 1.15:105331;
AVSCOM-TR-91-C-031) Avail: NTIS HC/MF A02

Low contact ratio spur gears were tested in the NASA gear noise rig to study the noise radiated from the top of the gearbox. The measured sound power from the gearbox top was obtained from a near field acoustic intensity scan taken at 63 nodes just above the surface. The sound power was measured at a matrix of 45 operating speeds and torque levels. Results are presented in the form of a spectral speed map and as a plot of sound power versus torque (at constant speed) and as sound power versus speed (at constant torque). Because of the presence of vibration modes, operating speed was found to have more impact on noise generation than torque level. A NASA gear dynamics code was used to compute the gear tooth dynamic overload at the same 45 operating conditions used for the experiment. Similar trends were found between the analytical results for dynamic tooth overload and experimental results for sound power. Dynamic analysis may be used to design high quality gears with profile relief optimized for minimum dynamic load and noise. Author

N92-26108*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPROVEMENT IN SURFACE FATIGUE LIFE OF HARDENED GEARS BY HIGH-INTENSITY SHOT PEENING
Dennis P. Townsend 1992 9 p Proposed for presentation at the Sixth International Power Transmission and Gearing Conference, Scottsdale, AZ, 13-16 Sep. 1992; sponsored by ASME
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105678; E-6986; NAS 1.15:105678;
AVSCOM-TR-91-C-042) Avail: NTIS HC/MF A02

Two groups of carburized, hardened, and ground spur gears that were manufactured from the same heat vacuum induction melted vacuum arc melted (VIM VAR) AISI 9310 steel were endurance tested for surface fatigue. Both groups were manufactured with a standard ground 16 rms surface finish. One group was subjected to a shot peening (SP) intensity of 7 to 9A, and the second group was subjected to a SP intensity of 15 to 17A. All gears were honed after SP to a surface finish of 16 rms. The gear pitch diameter was 8.89 cm. Test conditions were a maximum Hertz stress of 1.71 GPa, a gear temperature of 350 K, and a speed of 10000 rpm. The lubricant used for the tests was a synthetic paraffinic oil with an additive package. The following results were obtained: The 10 pct. surface fatigue (pitting) life of the high intensity (15 to 17A) SPed gears was 2.15 times that of the medium intensity (7 to 9A) SPed gears, the same as that calculated from measured residual stress at a depth of 127 microns. The measured residual stress for the high intensity SPed gears was 57 pct. higher than that for the medium intensity SPed gears at a depth of 127 microns and 540 pct. higher at a depth of 51 microns. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-25377 Physics and Electronics Lab. TNO, The Hague (Netherlands).
QUEST: QUALITY OF EXPERT SYSTEMS Final Report [QUEST: KWALITEIT VAN EXPERTSYSTEMEN]
Jacques H. J. Lenting (Limburg State Univ., Maastricht, Netherlands) and Michael Perre Nov. 1990 93 p
(Contract A89K602)
(FEL-90-A012; TD89-5095; ETN-92-91211) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

The problems encountered in expert systems development are analyzed and a quality framework which takes a view at the quality problem from three perspectives is developed: the quality of the development process, the quality of the specifications and the quality of the expert system viewed as a product. In order to get a better grasp of the problem a number of methods and techniques, derived from conventional and artificial intelligence systems development, are reviewed. The conceptual similarities between data bases and knowledge bases are stressed. The use of conventional specification methods, in particular Nijssens Information Analysis Methodology (NIAM), is considered. In addition to this, algorithms for preserving consistency and integrity of the knowledge base are compared. The modularity and structure of knowledge bases is examined, together with the applicability of conventional testing methodologies in expert systems. The integration of data base theory and artificial intelligence are shown to signify a step in the direction of a better quality control of expert systems. ESA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N92-25179*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMOMECHANICAL DEFORMATION BEHAVIOR OF A DYNAMIC STRAIN AGING ALLOY, HASTELLOY X
Michael G. Castelli, Robert V. Miner, and David N. Robinson (Akron Univ., OH.) Apr. 1992 27 p Presented at the Symposium on Thermomechanical Fatigue Behavior of Materials, San Diego, CA, 16 Oct. 1991; sponsored by the American Society for Testing and Materials
(Contract NAS3-25266)
(NASA-TM-105316; E-6899; NAS 1.15:105316) Avail: NTIS HC/MF A03

An experimental study was performed to identify the effects of dynamic strain aging (solute drag) and metallurgical instabilities under thermomechanical loading conditions. The study involved a series of closely controlled thermomechanical deformation tests on the solid-solution-strenghened nickel-base superalloy, Hastelloy X. This alloy exhibits a strong isothermal strain aging peak at approximately 600 C, promoted by the effects of solute drag and precipitation hardening. Macroscopic thermomechanical hardening trends are correlated with microstructural characteristics through the use of transmission electron microscopy. These observations are compared and contrasted with isothermal conditions. Thermomechanical behavior unique to the isothermal database is identified and discussed. The microstructural characteristics were shown to be dominated by effects associated with the highest temperature of the thermomechanical cycle. Results indicate that the deformation behavior of Hastelloy X is thermomechanically path dependent. In addition, guidance is given pertaining to deformation modeling in the context of macroscopic unified theory. An internal state variable is formulated to qualitatively reflect the isotropic hardening trends identified in the TMD experiments. Author

N92-25189 National Physical Lab., Teddington (England). Div. of Materials Matrology.
THE PALMQVIST TEST METHOD FOR TI-BASED CERMETS AND WC-Co HARDMETALS
M. G. Gee, L. A. Lay, and B. Roebuck Oct. 1991 74 p Sponsored by Commission of the European Communities
(NPL-DMM(A)-33; ISSN-0959-2423; ETN-92-91723) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Experiments performed to assess the measurement uncertainty in the Palmqvist method for toughness determination, which is based on measuring the length of cracks generated at the corners of Vickers hardness indentations are described. It was found that although the use of an optical microscope separate from that on the hardness machine gave slightly longer total crack lengths and indentations, the difference was barely greater than the measurement uncertainty. The use of a field emission Scanning Electron Microscope (SEM) gave high crack lengths, but low indentation diagonal measurements were obtained due to the difficulty in defining the corners of indentations in the SEM. When Palmqvist measurements were made on a range of cermets and hardmetals, it was found that the differences in the Palmqvist parameter from specimen to specimen in the materials examined were less then the experimental incertainty measured in the early part of the study. Annealing the specimens resulted in the measurement of longer crack lengths and indentation diagonals, and gave a significant reduction in the values of Palmqvist parameters. ESA

N92-25192*# Akron Univ., OH. Dept. of Mechanical Engineering.
SELF ADAPTIVE SOLUTION STRATEGIES: LOCALLY BOUND CONSTRAINED NEWTON RAPHSON SOLUTION ALGORITHMS Final Report
Joe Padovan Nov. 1991 76 p
(Grant NAG3-54)
(NASA-CR-189069; NAS 1.26:189069) Avail: NTIS HC/MF A05

A summary is given of strategies which enable the automatic adjustment of the constraint surfaces recently used to extend the range and numerical stability/efficiency of nonlinear finite element equation solvers. In addition to handling kinematic and material induced nonlinearity, both pre-and postbuckling behavior can be treated. The scheme employs localized bounds on various hierarchical partitions of the field variables. These are used to resize, shape, and orient the global constraint surface, thereby enabling essentially automatic load/deflection incrementation. Due

to the generality of the approach taken, it can be implemented in conjunction with the constraints of an arbitrary functional type. To benchmark the method, several numerical experiments are presented. These include problems involving kinematic and material nonlinearity, as well as pre- and postbuckling characteristics. Also included is a list of papers published in the course of the work. Author

N92-25267*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM: A GOVERNMENT OVERVIEW
Raymond G. Kvaternik Apr. 1992 12 p Presented at the 33rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Dallas, TX, 13-15 Apr. 1992
(NASA-TM-107579; NAS 1.15:107579) Avail: NTIS HC/MF A03

LaRC, under the Design Analysis Methods for Vibrations (DAMVIBS) Program, set out in 1984 to establish the technology base needed by the rotorcraft industry for developing an advanced finite-element-based dynamics design analysis capability for vibrations. Considerable work was performed by the industry participants in the program since that time. Because the DAMVIBS Program is being phased out, a government/industry assessment of the program was made to identify those accomplishments and contributions which may be ascribed to the program. The purpose is to provide an overview of the program and its accomplishments and contributions from the perspective of the government sponsoring organization. Author

N92-25295 National Physical Lab., Teddington (England). Div. of Materials Metrology.
FORCE CALIBRATION OF LEVER CREEP MACHINES
Malcolm S. Loveday Oct. 1991 28 p
(NPL-DMM(A)-40; ISSN-0959-2423; ETN-92-91376) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

The differences between the new British Standard BS 1610 Pt.3 'Specifications for the grading of forces applied by deadweight and lever creep machines' and the equivalent International Standard ISO 7500 Pt.2 are considered. The consequences of the adoption of the ISO standard as a European Standard which will supercede the British Standard are also highlighted. ESA

N92-25335*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ADAPTIVE UNSTRUCTURED MESHING FOR THERMAL STRESS ANALYSIS OF BUILT-UP STRUCTURES
Pramote Dechaumphai Feb. 1992 11 p Proposed for presentation at the AIAA 33rd Structures, Structural Dynamics and Materials Conference, Dallas, TX, 13-15 Apr. 1992
(NASA-TM-104221; NAS 1.15:104221) Avail: NTIS HC/MF A03

An adaptive unstructured meshing technique for mechanical and thermal stress analysis of built-up structures has been developed. A triangular membrane finite element and a new plate bending element are evaluated on a panel with a circular cutout and a frame stiffened panel. The adaptive unstructured meshing technique, without a priori knowledge of the solution to the problem, generates clustered elements only where needed. An improved solution accuracy is obtained at a reduced problem size and analysis computational time as compared to the results produced by the standard finite element procedure. Author

N92-25383# Technion - Israel Inst. of Tech., Haifa. Faculty of Aerospace Engineering.
PREDICTION OF CONSTANT-AMPLITUDE FATIGUE LIFE TO FAILURE UNDER PULSATING-TENSION (R GREATER THAN OR EQUAL TO O) BY USE OF THE LOCAL-STRAIN-APPROACH
A. Buch and V. Galperin Jun. 1991 28 p Sponsored in part by Louis Rogow Research Fund
(TAE-663) Avail: NTIS HC/MF A03

The aim was to compare Local Strain Approach (LSA) life prediction with pulsating-tension tests to failure. It is shown that, in the case of pulsating tension, the ratio N(sub i)/N(sub f) does not change considerably with the stress level and therefore LSA calculation can be of use for predicting S-N lines for R greater than or equal to O. The accuracy of the prediction is associated with choice of the K-value in Neuber's relation K(sub sigma) x K(sub epsilon) equals K(exp 2). The K-values which give the best life predictions were close to those of the corresponding notch factors for pulsating-tension (R = S(sub min)/S(sub max) = O). Because of the size and surface effects (which were not taken into account in LSA) and in view of the difficulty in knowing whether the specimen with a given K(sub F) value has exactly the same material parameters as those used in the LSA calculations, it is preferable to use a K-value proved to give predictions in agreement with a related pulsating-tension test. This K-value may be used for various combinations of S(sub a) and S(sub m) (S(sub a) greater than or equal to S(sub m) and S(sub max) less than S(sub y)). The results are valid for a specific specimen material, geometry, size, and surface finish. Author

N92-25386# ResTech Pittsburgh, PA.
FRACTURE SYSTEM IDENTIFICATION USING FORMATION MICROSCANNER DATA. ASHLAND EXPLORATION, INC., E. J. EVANS NUMBER 91, BREATHITT COUNTY, KENTUCKY
18 Jun. 1990 26 p
(Contract GRI-5086-213-1390)
(PB92-146059; GRI-90/0346) Avail: NTIS HC/MF A03

The information analyzed for fracture identification on the Comprehensive Study Well 4A included formation microscanner (FMS) data, whole core data, and borehole television information. While the FMS tool can be used to identify natural and induced fractures in the Devonian shale section, the comparative analysis shows that these fractures cannot be distinguished when using the borehole television camera. FMS data are included. GRA

N92-25387*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMPARISON OF CONTINUOUS AND DISCONTINUOUS COLLISIONAL BUMPERS: DIMENSIONALLY SCALED IMPACT EXPERIMENTS INTO SINGLE WIRE MESHES
Friedrich Hoerz, Mark Cintala, Thomas See, Ronald Bernhard, Frank Cardenas, William Davidson, and Jerry Haynes (Lockheed Engineering and Sciences Co., Houston, TX.) Apr. 1992 62 p Original contains color illustrations
(NASA-TM-104749; S-676; NAS 1.15:104749) Avail: NTIS HC/MF A04; 25 functional color pages

An experimental inquiry into the utility of discontinuous bumpers was conducted to investigate the collisional outcomes of impacts into single grid-like targets and to compare the results with more traditional bumper designs that employ continuous sheet stock. We performed some 35 experiments using 6.3 and 3.2 mm diameter spherical soda-lime glass projectiles at low velocities (less than 2.5 km/s) and 13 at velocities between 5 and 6 km/s, using 3.2 mm spheres only. The thrust of the experiments related to the characterization of collisional fragments as a function of target thickness or areal shield mass of both bumper designs. The primary product of these experiments was witness plates that record the resulting population of collisional fragments. Substantial interpretive and predictive insights into bumper performance were obtained. All qualitative observations (on the witness plates) and detailed measurements of displaced masses seem simply and consistently related only to bumper mass available for interaction with the impactor. This renders the grid bumper into the superior shield design. These findings present evidence that discontinuous bumpers are a viable concept for collisional shields, possibly superior to continuous geometries. Author

N92-25403# National Aerospace Lab., Tokyo (Japan).
DEVELOPMENT OF PRE- AND POST-PROCESSOR SYSTEM FOR STRUCTURAL ANALYSIS [KOZO KAISEKI YO PURI/POSUTO PUROSESSA SHISUTEMU NO KAIHATSU NI TSUITE]
Hidehito Okumura, Kunihiko Ootake, Shinichi Mineo, Osamu

Mochizuki, Kunihiko Kojima, and Kenji Shinohara Oct. 1990 20 p In JAPANESE Original contains color illustrations
(NAL-TM-628; ISSN-0452-2982; JTN-92-80315) Avail: NTIS HC/MF A03

A new CAE (Computer Aided Engineering) system for use in the design and analysis of aerospace technology was developed at NAL. The central part of the CAE system is general purpose structural analysis programs. The pre-processor consisted mainly from the three dimensional form modeling system and the FEM (Finite Element Method) modeling system. The former systems generate data for the analysis by FEM and converts the generated data to the next programs. And the post-processor system mainly consists of a graphic visualization system of the calculated results. And the integrated pre- and post-processor of CAE system consists of interfaces and communication files for the linkage with related systems. This CAE system is able to perform a series of work from model building to evaluations of results by the use of graphic terminals, and detailed designs of large structure components are possible by the use of this system. The overall designs, functions, and performances of the pre- and post-processor in the CAE system for structure research and development system are reported. Author (NASDA)

N92-25404# National Aerospace Lab., Tokyo (Japan). Aeroengine Div.
ACOUSTIC EMISSION ON FLEXURAL FRACTURE TEST OF SiC/Al COMPOSITES
Yasushi Sofue and Akinori Ogawa Nov. 1990 18 p In JAPANESE; ENGLISH summary
(NAL-TM-630; ISSN-0452-2982; JTN-92-80328) Avail: NTIS HC/MF A03

Fracture behavior of SiC/Al composites was investigated using three point flexural tests with Acoustic Emission (AE) measurement. Flexural tests were conducted for four different types of ply specimens (0 deg unidirectional, 0 deg unidirectional, 0 deg/90 deg ply, and +/- 45 deg ply) of each of the composite materials and the specimen of 6061 aluminum alloy. The AE amplitude was above 8 dB for the fiber breakage of the 0 deg unidirectional ply and 0 deg/90 deg ply specimen, while the 0 deg unidirectional ply and the +/- 45 deg ply specimen produced an AE amplitude below 72 dB for the interlaminar and interface fracture mode. Author (NASDA)

N92-25446*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STRUCTURAL OPTIMIZATION OF LARGE STRUCTURAL SYSTEMS BY OPTIMALITY CRITERIA METHODS
Laszlo Berke 1992 23 p Presented at the Lecture Series on Shape and Layout Optimization of Structural Systems, Udine, Italy, 16-20 Jul. 1990
(NASA-TM-105423; E-5506; NAS 1.15:105423) Avail: NTIS HC/MF A03

The fundamental concepts of the optimality criteria method of structural optimization are presented. The effect of the separability properties of the objective and constraint functions on the optimality criteria expressions is emphasized. The single constraint case is treated first, followed by the multiple constraint case with a more complex evaluation of the Lagrange multipliers. Examples illustrate the efficiency of the method. Author

N92-25452 National Physical Lab., Teddington (England). Div. of Materials Metrology.
STANDARDS FOR THE CALIBRATION OF EXTENSOMETERS
Malcolm S. Loveday Oct. 1991 34 p
(NPL-DMM(A)-41; ISSN-0959-2423; ETN-92-91377) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

The consequences of the impending publication of a new European Standard, BS EN 10002 Pt 4 'Metallic Materials: Verification of Extensometers Used in Uniaxial Testing', which was based on the equivalent International Standard ISO 9513, are considered within the context of the new standard superceding the present British Standard, BS 3846. The three standards are compared and the differences are highlighted. ESA

N92-25546 Georgia Inst. of Tech., Atlanta.
THERMO-ELASTOVISCOPLASTIC POSTBUCKLING BEHAVIOR OF SHELL-LIKE STRUCTURES Ph.D. Thesis
Yuzhao Song 1991 143 p
Avail: Univ. Microfilms Order No. DA9206109

Buckling is one of the basic failure forms in shell-like structures. For the structures operated at high temperature environments, the buckling load may decrease significantly. Therefore, stability, including the postbuckling behavior, becomes a main concern of designers. The thermo-elastoviscoplastic prebuckling, buckling and postbuckling behaviors of shell-like structures are investigated. Unified constitutive equations, as a viscoplastic material behavior model, are employed. The material behavior model does not separate the time-dependent (plastic) and time-dependent (creep) deformations and can cover elastic, inelastic and temperature effects simultaneously. Both Bodner-Partom and Walker's models are used, and comparisons of the results with the two models are presented. Because of the nonlinearity of the geometrical and constitutive equations, a finite element approach is employed to predict the inelastic response. A solution scheme, which can deal with the limit point instability problems with unified constitutive equations was developed. Numerical examples are given for several structures which include columns, arches, plates, cylindrical shells and panels. Parametric studies are performed for the investigated structures. The effects of temperature, of small initial imperfections and of thickness are the emphasis of the study. Creep buckling, as an example of time-dependent deformation, is also investigated. The results of these studies demonstrate that (1) the buckling load as well as the load carrying capability decrease as temperature increases (for material B1900+Hf, when temperature is higher than 700 C, the load carrying capability decreases drastically); (2) the shell-like structures are generally imperfection sensitive in the plastic range (thicker wall case), but it is not as sensitive as in the elastic range (very thin wall case); (3) the results from Bodner-Partom and Walker's models are reasonably close for the investigated structures; and (4) at high temperatures, the unified constitutive equations provide a good model for material behavior in dealing with the stability problem of structures. Dissert. Abstr.

N92-25568 Virginia Polytechnic Inst. and State Univ., Blacksburg.
FORCED, NONLINEAR, PLANAR, AND NONPLANAR OSCILLATIONS OF A CANTILEVERED BEAM INCLUDING STATIC DEFLECTION Ph.D. Thesis
In-Ming Kevin Shyu 1991 286 p
Avail: Univ. Microfilms Order No. DA9208435

In this dissertation, the response of a slender, elastic, cantilevered beam to a simple harmonic excitation is investigated. The effects of nonlinear curvature, nonlinear inertia, viscous damping and static load are included. The nonlinear equations governing the motion of the beam are derived by the Lagrangian approach. The deflections are expressed as expansions in terms of the linear free-vibration modes. Galerkin's method is used to eliminate the spatial functions from the governing equations. Three modes are used in this procedure. Approximate solutions of the temporal equations are determined by the method of multiple scales. Four first-order ordinary differential equations govern the amplitudes and phases, and predict a whirling motion under certain situations. The solutions of the modulation equations can be fixed points, limit cycles or chaotic motions. Previous studies considered whirling produced by a primary resonance. In this dissertation, secondary resonances are considered in addition to primary resonance. Previous derivations of equations of motion contain only the linear and cubic terms without consideration of the static displacement produced by the weight of the beam. As a result of this static deflection, there are quadratic terms in the governing equations which introduce the possibility of a superharmonic resonance of order two and a subharmonic resonance of order two. Dissert. Abstr.

N92-25589 Old Dominion Univ., Norfolk, VA.
FINITE ELEMENT FREQUENCY DOMAIN SOLUTION OF NONLINEAR PANEL FLUTTER WITH TEMPERATURE EFFECTS AND FATIGUE LIFE ANALYSIS Ph.D. Thesis
David Yongxiang Xue 1991 189 p
Avail: Univ. Microfilms Order No. DA9208330

A frequency domain solution method for nonlinear panel flutter with thermal effects using a consistent finite element formulation has been developed. The von Karman nonlinear 'strain displacement' relation is used to account for large deflections, the quasi-steady first-order piston theory is employed for aerodynamic loading and the quasi-steady thermal stress theory is applied for the thermal stresses with a given change of the temperature distribution, Delta T(x, y, z). The equation of motion under a combined thermal-aerodynamic loading can be mathematically separated into two equations and then solved in sequence: (1) thermal-aerodynamic postbuckling and (2) limit-cycle oscillation. The Newton-Raphson iteration technique is used to solve the nonlinear algebraic equations and an updated linearized eigensolution procedure is adopted to solve the nonlinear differential equations. The finite element frequency domain solution results are compared with numerical time integration results. Limit-cycle responses, flutter boundaries, snap-through areas and stress distributions are obtained from the present analyses. The effects of different temperature distributions, panel aspect ratios and boundary support conditions are investigated. Dissert. Abstr.

N92-25642 Florida Univ., Gainesville.
FINITE ELEMENT ANALYSIS OF VISCOELASTICALLY DAMPED COMPOSITE STRUCTURES Ph.D. Thesis
Vidish Subba Rao 1991 205 p
Avail: Univ. Microfilms Order No. DA9209067

This study examines the potential for using passive viscoelastic damping treatments to improve the response characteristics of composite structures. An efficient finite element analysis model for estimating the response characteristics of viscoelastically damped, prestressed, laminated composite structures is presented. Specialized structural and continuum finite elements, ideally suited to analyze such structures, were formulated and implemented in a stand-alone finite element code, UFPAC, which was developed in this work. Techniques for estimating dynamic response characteristics of the structure about prestressed configurations were also implemented in the finite element code. The finite element formulation is based on the incremental virtual work principle of nonlinear elasticity. The equations of motion are linearized about the prestressed configuration so that the nonlinearity considered in the final analysis is limited to the stiffening/slackening effect of a linear preload. The required response characteristics about the prestressed configuration are obtained by solving the resulting equations of motion appropriately. Loss factor, a measure of damping ability, was a key parameter in this study. Finite element method-based techniques to estimate overall loss factor based on the knowledge of the loss factors of the constituent materials that form the composite structure are discussed. The modifications required in the damping estimation models to account for the prestressed state of the structure are presented. A simple experimental method to measure damping ability is described. The experiments were used mainly to provide loss factor data which were supplied as input in the finite element analysis. Some of the finite element predictions were compared with experimental results to verify the analytical model for the prediction of damping. Several other examples that verify the accuracy of the finite element formulation are also presented.
Dissert. Abstr.

N92-25753*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STRUCTURAL ANALYSIS OF LOW-SPEED COMPOSITE PROPFAN BLADES FOR THE LRCSW WIND TUNNEL MODEL
Michael A. Ernst Jan. 1992 27 p Original contains color illustrations
(NASA-TM-105266; E-6291; NAS 1.15:105266) Avail: NTIS HC/MF A03; 1 functional color page

The Naval Weapons Center at China Lake, CA, is currently in the process of evaluating propulsion systems for the Long Range Conventional Standoff Weapons (LRCSW). At present, the Advanced Counter-Rotating Propfan system is being considered. The methodologies are documented which were used to structurally analyze the 0.55 scale CM1 composite propfan blades for the LRCSW with COBSTRAN and MSC/NASTRAN. Significant results are also reported.
Author

N92-25757# Pacific Northwest Lab., Richland, WA.
EVALUATION OF MINIATURE TENSILE SPECIMEN FABRICATION TECHNIQUES AND PERFORMANCE
M. L. Hamilton, M. A. Blotter, and D. J. Edwards (Missouri Univ., Rolla.) Jan. 1992 24 p Presented at the ASTM International Symposium on Small Specimen Test Techniques and Their Applications To Nuclear Reactor Vessel Thermal Annealing and Plant Life Extension, New Orleans, LA, 29-31 Jan. 1992
(Contract DE-AC06-76RL-01830)
(DE92-010074; PNL-SA-19684; CONF-920146-2) Avail: NTIS HC/MF A03

The confident application of miniature tensile specimens requires adequate control over their fabrication and is facilitated by automated test and analysis techniques. Three fabrication processes (punching, chemical milling, and electrical discharge machining (EDM)) were recently evaluated, leading to the replacement of the previously used punching technique with a wire EDM technique. The automated data acquisition system was upgraded, and an interactive data analysis program was developed.
DOE

N92-25911*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTATIONAL STRUCTURES TECHNOLOGY FOR AIRFRAMES AND PROPULSION SYSTEMS
Ahmed K. Noor, comp., Jerrold M. Housner, comp., James H. Starnes, Jr., comp., Dale A. Hopkins, comp., and Christos C. Chamis, comp. (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Washington May 1992 516 p Workshops held in Cleveland, OH, 26-27 Jun. 1991 and in Hampton, VA, 4-5 Sep. 1991; sponsored by NASA, Washington and Virginia Univ., Hampton
(NASA-CP-3142; L-17049; NAS 1.55:3142) Avail: NTIS HC/MF A22

This conference publication contains the presentations and discussions from the joint University of Virginia (UVA)/NASA Workshops. The presentations included NASA Headquarters perspectives on High Speed Civil Transport (HSCT), goals and objectives of the UVA Center for Computational Structures Technology (CST), NASA and Air Force CST activities, CST activities for airframes and propulsion systems in industry, and CST activities at Sandia National Laboratory. For individual titles, see N92-25912 through N92-25935.

N92-25912*# Virginia Univ., Charlottesville.
COMPUTATIONAL STRUCTURES TECHNOLOGY AND UVA CENTER FOR CST
Ahmed K. Noor *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 5-41 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Rapid advances in computer hardware have had a profound effect on various engineering and mechanics disciplines, including the materials, structures, and dynamics disciplines. A new technology, computational structures technology (CST), has recently emerged as an insightful blend between material modeling, structural and dynamic analysis and synthesis on the one hand, and other disciplines such as computer science, numerical analysis, and approximation theory, on the other hand. CST is an outgrowth of finite element methods developed over the last three decades. The focus of this presentation is on some aspects of CST which can impact future airframes and propulsion systems, as well as on the newly established University of Virginia (UVA) Center for

CST. The background and goals for CST are described along with the motivations for developing CST, and a brief discussion is made on computational material modeling. We look at the future in terms of technical needs, computing environment, and research directions. The newly established UVA Center for CST is described. One of the research projects of the Center is described, and a brief summary of the presentation is given. Author

N92-25913*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTER CODES DEVELOPED AND UNDER DEVELOPMENT AT LEWIS **c61**
Christos C. Chamis *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 43-57 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The objective of this summary is to provide a brief description of: (1) codes developed or under development at LeRC; and (2) the development status of IPACS with some typical early results. The computer codes that have been developed and/or are under development at LeRC are listed in the accompanying charts. This list includes: (1) the code acronym; (2) select physics descriptors; (3) current enhancements; and (4) present (9/91) code status with respect to its availability and documentation. The computer codes list is grouped by related functions such as: (1) composite mechanics; (2) composite structures; (3) integrated and 3-D analysis; (4) structural tailoring; and (5) probabilistic structural analysis. These codes provide a broad computational simulation infrastructure (technology base-readiness) for assessing the structural integrity/durability/reliability of propulsion systems. These codes serve two other very important functions: they provide an effective means of technology transfer; and they constitute a depository of corporate memory. Author

N92-25914*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PROGRESS IN INTEGRATED ANALYSIS WITH ADAPTIVE UNSTRUCTURED MESHING
Pramote Dechaumphai *In its* Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 59-79 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Design of lightweight structures and thermal protection systems for hypersonic vehicles depend on accurate prediction of aerothermal loads, structural temperatures and their gradients, and structural deformations and stresses. Concentration is on an alternative meshing technique which generates an entirely new adaptive unstructured mesh based on the solution obtained from the earlier mesh. The technique combined with the finite element method has been shown to significantly improve the efficiency and accuracy of the fluid, thermal, and structural analyses. Current capability of the adaptive unstructured meshing technique for the integrated fluid-thermal-structural analysis is described first. The technique was extended to transient thermal analysis of structures with time-dependent adaptive meshing to capture the detailed temperature response with a minimum number of unknowns and computational cost. Both linear and higher-order finite elements are implemented to demonstrate the generality of the technique and to investigate their solution accuracy. Currently, the adaptive meshing technique is being developed for plane structures that can be modeled with membrane elements and built-up structures modeled with membrane and bending elements. The capability of the technique to these different disciplinary problems is demonstrated by several examples. Author

N92-25915*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A BRIEF OVERVIEW OF COMPUTATIONAL STRUCTURES TECHNOLOGY RELATED ACTIVITIES AT NASA LEWIS RESEARCH CENTER
Dale A. Hopkins *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 81-89 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The presentation gives a partial overview of research and development underway in the Structures Division of LeRC, which collectively is referred to as the Computational Structures Technology Program. The activities in the program are diverse and encompass four major categories: (1) composite materials and structures; (2) probabilistic analysis and reliability; (3) design optimization and expert systems; and (4) computational methods and simulation. The approach of the program is comprehensive and entails exploration of fundamental theories of structural mechanics to accurately represent the complex physics governing engine structural performance, formulation, and implementation of computational techniques and integrated simulation strategies to provide accurate and efficient solutions of the governing theoretical models by exploiting the emerging advances in computer technology, and validation and verification through numerical and experimental tests to establish confidence and define the qualities and limitations of the resulting theoretical models and computational solutions. The program comprises both in-house and sponsored research activities. The remainder of the presentation provides a sample of activities to illustrate the breadth and depth of the program and to demonstrate the accomplishments and benefits that have resulted. Author

N92-25916*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CSM ACTIVITIES AT THE NASA LANGLEY RESEARCH CENTER
Jerrold M. Housner *In its* Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 91-120 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The objective and goals of the Computational Structural Mechanics (CSM) Program as applied to airframe structures are given. It is recognized that the rapid evolution of computer hardware has opened up new opportunities for solving more complex and larger structural analysis problems than was hitherto imagined. To utilize these computers, new methods of computational structural mechanics are required. Methods are now being developed, assessed, and validated to meet the goals, and each of these goals is addressed. Plans and approaches are shown and highlights of results achieved in meeting these goals are given. Three research thrusts are shown in the five-year plan: advanced robust CSM methods, large-scale solutions, and validation/demonstration studies. The areas of research activity reflect the CSM goals. The mapping of developed methods onto high-performance and massively parallel computers is an integral part of the CSM five-year plan. Author

N92-25917*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OVERVIEW OF MECHANICS OF MATERIALS BRANCH ACTIVITIES IN THE COMPUTATIONAL STRUCTURES AREA
C. C. Poe, Jr. *In its* Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 121-136 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Base programs and system programs are discussed. The base programs include fundamental research of composites and metals for airframes leading to characterization of advanced materials, models of behavior, and methods for predicting damage tolerance. Results from the base programs support the systems programs, which change as NASA's missions change. The National Aerospace Plane (NASP), Advanced Composites Technology (ACT), Airframe Structural Integrity Program (Aging Aircraft), and High Speed Research (HSR) programs are currently being supported. Airframe durability is one of the key issues in each of these system programs. The base program has four major thrusts, which will be reviewed subsequently. Additionally, several technical highlights will be reviewed for each thrust. Author

N92-25918*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ANALYSIS AND DESIGN TECHNOLOGY FOR HIGH-SPEED AIRCRAFT STRUCTURES
James H. Starnes, Jr. and Charles J. Camarda *In its* Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 137-172 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Recent high-speed aircraft structures research activities at NASA Langley Research Center are described. The following topics are covered: the development of analytical and numerical solutions to global and local thermal and structural problems, experimental verification of analysis methods, identification of failure mechanisms, and the incorporation of analysis methods into design and optimization strategies. The paper describes recent NASA Langley advances in analysis and design methods, structural and thermal concepts, and test methods. Author

N92-25919*# General Electric Co., Cincinnati, OH. Aircraft Engines.
HIGH SPEED CIVIL TRANSPORT **c05**
R. L. McKnight *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 173-188 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The design requirements of the High Speed Civil Transport (HSCT) are discussed. The following design concerns are presented: (1) environmental impact (emissions and noise); (2) critical components (the high temperature combustor and the lightweight exhaust nozzle); and (3) advanced materials (high temperature ceramic matrix composites (CMC's)/intermetallic matrix composites (IMC's)/metal matrix composites (MMC's)). Author

N92-25920*# Pratt and Whitney Aircraft, West Palm Beach, FL.
STRUCTURES TECHNOLOGY APPLICATIONS FOR THE NATIONAL AEROSPACE PLANE **c05**
T. E. Little *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 189-208 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The National AeroSpace Plane (NASP) presents a unique set of very complex structural problems that challenge our computational capabilities. Complex analyses are required in the conceptual design phase to achieve sufficient accuracy to address the extreme load conditions and to adequately evaluate vehicle weight. The computational capability must be available to perform these analyses in a rapid manner to accommodate the design process. Author

N92-25921*# Wright Lab., Wright-Patterson AFB, OH.
LARGE SCALE OPTIMIZATION USING ASTROS: AN OVERVIEW **c05**
Vipperla B. Venkayya *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 209-230 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Interest in interdisciplinary systems is widespread around the world. A number of structural optimization systems are being developed and tested. Some examples are listed here. ASOP, FASTOP, and TSO are programs developed for the Air Force Flight Dynamics Laboratory during the seventies. These programs established the feasibility of integrating various disciplines. The program 'STARS' is basically a structural optimization system developed by the Royal Aircraft Establishment (RAE) in England. At present, it is being enhanced to include aeroelasticity. 'LAGRANGE' is an optimization system developed by MBB in Germany. ELFINI is a similar system developed in France. It is being marketed in the U.S. as well as other countries. The Automated STRuctural Optimization System (ASTROS) was developed for the Flight Dynamics Directorate of Wright Laboratory. The ASTROS system is described in viewgraph form. Author

N92-25922*# Virginia Univ., Charlottesville. Light Thermal Structures Center.
LIGHT THERMAL STRUCTURES AND MATERIALS FOR HIGH SPEED FLIGHT **c05**
Earl A. Thornton *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 231-251 Sponsored in part by Virginia Univ. Academic Enhancement Program (For primary document see N92-25911 16-39)
(Grants NAG1-745; NAG1-1013)
Avail: NTIS HC/MF A22

Over the last twenty years, unified viscoplastic constitutive models have evolved to meet this need. These constitutive models provide a means for representing a material's response from the elastic through the plastic range including strain-rate dependent plastic flow, creep, and stress relaxation. Rate-dependent plasticity effects are known to be important at elevated temperatures. The purpose of this paper is to describe computational and experimental research programs underway at the Light Thermal Structures Center focused on the investigation of the response of structures and materials to local heating. In the first part of the paper, finite element thermoviscoplastic analysis is highlighted. In the second part of the paper, the thermal-structures experimental program is outlined. Author

N92-25923*# California Univ., Santa Barbara.
MODELING BRITTLE HIGH-TEMPERATURE COMPOSITE STRUCTURES **c24**
K. T. Kedward, R. M. McMeeking, and S. Janson *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 253-268 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

A major inhibitor to the projected application of brittle matrix composite structures, such as ceramic matrix composites (CMC), to advanced high temperature airframes is premature matrix microcracking. However, the phenomenon has been experienced with polymer matrix composite (PMC) systems that are now in an advanced stage of development. Consequently, the subsequent mechanical behavior of these composite systems must be predictable, which demands a more complete understanding of the mechanisms such as nonlinear features, localized breakdown of the matrix, interface, and fiber phases. To establish the need for such development we will commence with a review of the key differences between polymer, and ceramic as well as metal matrix composites (MMC). Next some lessons learned from the development of the most mature PMC structures will be discussed to indicate how this experience may be carried over to assist the development on high temperature composites subjected to monotonic and cyclic loads as discussed and selected areas for future technical development are indicated. Author

N92-25924*# General Electric Co., Cincinnati, OH. Aircraft Engines.
ALGORITHMIC DEVELOPMENT IN STRUCTURES TECHNOLOGY
Frank Sagendorph *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 269-302 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

A wide variety of topics about the types of algorithms in use or in development for the design of gas turbine engines are covered in this report, ranging from the need for better algorithms, to how they should be used. The areas to be addressed in viewgraph format are: why development is needed; how to prioritize it; what is the computing environment; who needs new methods; examples; and the importance of validation. H.A.

N92-25925*# Sandia National Labs., Albuquerque, NM.
STRUCTURAL MECHANICS SIMULATIONS
Johnny H. Biffle *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 303-320 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Sandia National Laboratory has a very broad structural capability. Work has been performed in support of reentry vehicles, nuclear reactor safety, weapons systems and components, nuclear waste transport, strategic petroleum reserve, nuclear waste storage, wind and solar energy, drilling technology, and submarine programs. The analysis environment contains both commercial and internally developed software. Included are mesh generation capabilities, structural simulation codes, and visual codes for examining simulation results. To effectively simulate a wide variety of physical phenomena, a large number of constitutive models have been developed. Author

N92-25926*# Boeing Commercial Airplane Co., Seattle, WA. Technology and Product Development.
STRUCTURAL ANALYSIS FOR PRELIMINARY DESIGN OF HIGH SPEED CIVIL TRANSPORT (HSCT)
Kumar G. Bhatia *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 321-334 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

In the preliminary design environment, there is a need for quick evaluation of configuration and material concepts. The simplified beam representations used in the subsonic, high aspect ratio wing platform are not applicable for low aspect ratio configurations typical of supersonic transports. There is a requirement to develop methods for efficient generation of structural arrangement and finite element representation to support multidisciplinary analysis and optimization. In addition, empirical data bases required to validate prediction methods need to be improved for high speed civil transport (HSCT) type configurations. H.A.

N92-25927*# McDonnell-Douglas Corp., Saint Louis, MO.
APPLICATION OF INTEGRATED STRUCTURAL ANALYSIS TO THE HIGH SPEED CIVIL TRANSPORT
C. R. Saff *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 335-357 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The Integrated Structural Analysis (ISA) system was developed in response to the need to define lightweight structures early in the design process for military aircraft. The objective of the ISA system is to permit rapid development of an optimized skin and big-bones structure that insures that the requirements of strength, dynamics, loads, and weight are met. While the system was originally developed for fighter aircraft, it is applicable to commercial transports or any other structures. The design requirements dictate the structural arrangement and sizing limitations to be imposed. H.A.

N92-25928*# Northrop Corp., Hawthorne, CA. Structural Methods and Applications Dept.
OVERVIEW OF COMPUTATIONAL STRUCTURAL METHODS FOR MODERN MILITARY AIRCRAFT
J. N. Kudva *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 359-373 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Computational structural methods are essential for designing modern military aircraft. This briefing deals with computational structural methods (CSM) currently used. First a brief summary of modern day aircraft structural design procedures is presented. Following this, several ongoing CSM related projects at Northrop are discussed. Finally, shortcomings in this area, future requirements, and summary remarks are given. H.A.

N92-25929*# Rockwell International Corp., El Segundo, CA.
A PERSPECTIVE ON TECHNICAL NEEDS IN COMPUTATIONAL STRUCTURES TECHNOLOGY
Frank F. Abdi, Gregory L. Savoni, and Kenneth J. Newell *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 375-393 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The wide spectrum of needs and applications are demonstrated of computational structural mechanics. The spectrum ranges from micro structural mechanics to the optimization of the performance of aerovehicles. Critical high leveraged technologies will require engineering process modernization and automation, affordable structures and materials, and advanced computational technology. Recent advances at Rockwell International in computational structural mechanics addressed these issues and improve the ability to achieve advanced aircraft objectives. Author

N92-25930*# Grumman Aerospace Corp., Bethpage, NY. Applied Mechanics Lab.
COMPUTATIONAL STRUCTURES TECHNOLOGY AT GRUMMAN: CURRENT PRACTICE/FUTURE NEEDS
Allan B. Pifko and Harvey Eidinoff *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 395-429 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The current practice for the design analysis of new airframe structural systems is to construct a master finite element model of the vehicle in order to develop internal load distributions. The inputs to this model include the geometry which is taken directly from CADAM and CATIA structural layout and aerodynamic loads and mass distribution computer models. This master model is sufficiently detailed to define major load paths and for the computation of dynamic mode shapes and structural frequencies, but not detailed enough to define local stress gradients and notch stresses. This master model is then used to perform structural optimization studies that will provide minimum weights for major structural members. The post-processed output from the master model, load, stress, and strain analysis is then used by structural analysts to perform detailed stress analysis of local regions in order to design local structure with all its required details. This local analysis consists of hand stress analysis and life prediction analysis with the assistance of manuals, design charts, computer stress and structural life analysis and sometimes finite element or boundary element analysis. The resulting design is verified by fatigue tests. Author

N92-25931*# Wright Lab., Wright-Patterson AFB, OH.
AIRFRAME LIFE PREDICTION **c05**
G. P. Sendeckyj *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 431-445 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The required research to develop improved life prediction methods for metallic and composite structures under severe thermomechanical loading must include the development of a verified thermoinelastic fracture criterion. There has been much work in this area with many fracture criteria being proposed. Due to the lack of adequate experimental verification none of them are widely accepted. Research must also be performed to develop and implement improved thermoinelasticity theories that properly model large temperature excursions and high temperature gradient. This research is required to provide confidence in the simpler theories currently used for thermoinelastic analysis. Finally, experimental data is needed to define the behavior of and damage accumulation process in thermoinelastic materials. Special emphasis must be placed on understanding failure mode transitions under thermomechanical loading conditions. Author

N92-25932*# Rockwell International Corp., Huntsville, AL.
PROBABILISTIC DESIGN APPLICATIONS FOR THE SPACE TRANSPORTATION MAIN ENGINES **c20**
Kevin OHara *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 447-471 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

All of the current rocket engine designs are based on deterministic design analysis methods. The most recently designed engine, Space Shuttle Main Engines (SSME), was designed and developed using these techniques in the 1970's and 80's. The Space Transportation Main Engine (STME) design objective is to use a robust design methodology and to pro-actively assess and improve the design during the design process. The design approach is a combination of the traditional deterministic methodologies and recently developed probabilistic methodologies. The designer must use a more rigorous structural criteria, conduct pro-active reliability assessments (reliability allocations, failure modes and effects analysis, reliability growth studies, and design reliability assessment), use a damage tolerant design philosophy and perform probabilistic analyses. Rigorous application of this structured methodology will develop a better engine product. Author

N92-25933*# Pratt and Whitney Aircraft, East Hartford, CT.
COMPUTATIONAL STRUCTURAL ANALYSIS AND ADVANCED COMMERCIAL ENGINES **c07**
R. B. Wilson *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 473-490 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

The history of computational structural analysis is reviewed and anticipated requirements for the design, development, and support of advanced commercial engines is discussed. The present commercial engine environment is comprised primarily of turbofan engines containing monolithic titanium and nickel alloys. Future commercial engines will make extensive use of composite materials to meet demanding high temperature requirement and aggressive weight goals, since only modestly higher capabilities can be anticipated in monolithic materials. Engine configurations will include ducted and/or unducted propfans and super turbojet in addition to turbofans. Author

N92-25934*# Wright Lab., Wright-Patterson AFB, OH.
MILITARY ENGINE COMPUTATIONAL STRUCTURES TECHNOLOGY **c07**
Daniel E. Thomson *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 491-506 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Integrated High Performance Turbine Engine Technology Initiative (IHPTET) goals require a strong analytical base. Effective analysis of composite materials is critical to life analysis and structural optimization. Accurate life prediction for all material systems is critical. User friendly systems are also desirable. Post processing of results is very important. The IHPTET goal is to double turbine engine propulsion capability by the year 2003. Fifty percent of the goal will come from advanced materials and structures, the other 50 percent will come from increasing performance. Computer programs are listed. Author

N92-25935*# General Electric Co., Cincinnati, OH.
COMPUTATIONAL STRUCTURES TECHNOLOGY ENGINE/AIRFRAME COUPLING **c05**
Bruce C. McClintick *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 507-520 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

Many aspects of engine/airframe coupling which are related to structures are examined. The generation and analysis is studied of full 3-D engine structures with regard to the design and operation of the engine under static load conditions. However, several problems arose which required the use of the three dimensional models under dynamic loads to more fully understand what was happening. Full 3-D engine structural models have been used on a regular basis to help understand dynamics related problems. One such problem, addressed herein, is engine related aircraft vibration. Engine related aircraft vibration is noise within the fuselage of the aircraft which can be both felt and heard. To effectively predict engine related aircraft vibration, the entire engine/airframe must be treated as a system. Author

N92-25960*# Analytical Services and Materials, Inc., Hampton, VA.
PRELIMINARY STRUCTURAL SIZING OF A MACH 3.0 HIGH-SPEED CIVIL TRANSPORT MODEL
Charles L. Blackburn Apr. 1992 50 p
(Contract NAS1-19317)
(NASA-CR-189631; NAS 1.26:189631) Avail: NTIS HC/MF A03

An analysis has been performed pertaining to the structural resizing of a candidate Mach 3.0 High Speed Civil Transport (HSCT) conceptual design using a computer program called EZDESIT. EZDESIT is a computer program which integrates the PATRAN finite element modeling program to the COMET finite element analysis program for the purpose of calculating element sizes or cross sectional dimensions. The purpose of the present report is to document the procedure used in accomplishing the preliminary structural sizing and to present the corresponding results. Author

N92-25997*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRESS CONCENTRATIONS FOR STRAIGHT-SHANK AND COUNTERSUNK HOLES IN PLATES SUBJECTED TO TENSION, BENDING, AND PIN LOADING
K. N. Shivakumar (Analytical Services and Materials, Inc., Hampton, VA.) and J. C. Newman, Jr. Jun. 1992 36 p
(NASA-TP-3192; L-17027; NAS 1.60:3192) Avail: NTIS HC/MF A03

A three dimensional stress concentration analysis was conducted on straight shank and countersunk (rivet) holes in a large plate subjected to various loading conditions. Three dimensional finite element analysis were performed with 20 node isoparametric elements. The plate material was assumed to be linear elastic and isotropic, with a Poisson ratio of 0.3. Stress concentration along the bore of the hole were computed for several ratios of hole radius to plate thickness (0.1 to 2.5) and ratios of countersink depth to plate thickness (0.25 to 1). The countersink angles were varied from 80 to 100 degrees in some typical cases, but the angle was held constant at 100 degrees for most cases. For straight shank holes, three types of loading were considered: remote tension, remote bending, and wedge loading in the hole. Results for remote tension and wedge loading were used to estimate stress concentration for simulated rivet in pin loading. For countersunk holes only remote tension and bending were considered. Based on the finite element results, stress concentration equations were developed. Whenever possible, the present results were compared with other numerical solutions and experimental results from the literature. Author

N92-26124* Institute for Computer Applications in Science and Engineering, Hampton, VA.
APPROXIMATION METHODS FOR CONTROL OF ACOUSTIC/STRUCTURE MODELS WITH PIEZOCERAMIC ACTUATORS Abstract Only
H. T. Banks, W. Fang, R. J. Silcox (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), and R. C. Smith Jun. 1991 2 p
(Contract NAS1-18107; NAG1-1116; AF-AFOSR-0091-90)
(NASA-CR-190322; NAS 1.26:190322) Avail: Issuing Activity

The active control of acoustic pressure in a 2-D cavity with a flexible boundary (a beam) is considered. Specifically, this control is implemented via piezoceramic patches on the beam which

produce pure bending moments. The incorporation of the feedback control in this manner leads to a system with an unbounded input term. Approximation methods in the context of an LQR state space formulation are discussed and numerical results demonstrating the effectiveness of this approach in computing feedback controls for noise reduction are presented. Author

N92-26125* University of Southern California, Los Angeles. Center for Applied Mathematical Sciences.
ACTIVE NOISE CONTROL: PIEZOCERAMIC ACTUATORS IN FLUID/STRUCTURE INTERACTION MODELS Abstract Only
H. T. Banks, W. Fang, and R. C. Smith (Institute for Computer Applications in Science and Engineering, Hampton, VA.) Jun. 1991 2 p
(Contract NAS1-18107; NAG1-1116; AF-AFOSR-0091-90)
(NASA-CR-190328; NAS 1.26:190328) Avail: Issuing Activity

A model for a 2-D acoustic cavity with a flexible boundary (a beam) controlled via piezoceramic patches producing bending moments in the beam is considered. The associated control problem for this fluid/structure interaction system to reduce the acoustic pressure in the cavity involves unbounded control inputs. Approximation methods in the context of an LQR state space formulation are discussed and numerical results are presented to demonstrate the effectiveness of this approach in computing feedback controls for noise reduction. Author

N92-26127* University of Southern California, Los Angeles. Center for Applied Mathematical Sciences.
BENDING AND SHEAR DAMPING IN BEAMS: FREQUENCY DOMAIN ESTIMATION TECHNIQUES
H. T. Banks, Y. Wang, and D. J. Inman (State Univ. of New York, Buffalo.) Sep. 1991 2 p
(Contract NAS1-18107; NAG1-1116; AF-AFOSR-0091-90)
(NASA-CR-190323; NAS 1.26:190323) Avail: Issuing Activity

Damping mechanisms are considered in the context of dynamic beam models. Previous efforts are summarized on various damping models (strain rate or Kelvin-Voigt, time hysteresis (Boltzmann), spatial hysteresis, bending rate/square root) for the Euler-Bernoulli beam theory. The Euler-Bernoulli theory is known to be inadequate for experiments in which high frequency modes have been excited. In such cases the Timoshenko theory may be more appropriate; a number of damping hypotheses were considered for this theory. Corresponding models are proposed and compared to experimental data in the context of parameter estimation or identification problems formulated in the frequency domain. Theoretical results related to the convergence of approximations to these infinite dimensional distributed parameter system estimation problems are presented. Associated computational findings for specific beam experiments are discussed. Author

N92-26128*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRESS-STRAIN ANALYSIS OF A (0/90)SUB 2 SYMMETRIC TITANIUM MATRIX LAMINATE SUBJECTED TO A GENERIC HYPERSONIC FLIGHT PROFILE
Massoud Mirdamadi (National Academy of Sciences - National Research Council, Hampton, VA.) and W. Steven Johnson Mar. 1992 27 p Sponsored in part by NAS-NRC
(NASA-TM-107584; NAS 1.15:107584) Avail: NTIS HC/MF A03

Cross ply laminate behavior of Ti-15V-3Cr-3Al-3Sn (Ti-15-3) matrix reinforced with continuous silicon carbide fibers (SCS-6) subjected to a generic hypersonic flight profile was evaluated experimentally and analytically. Thermomechanical fatigue test techniques were developed to conduct a simulation of a generic hypersonic flight profile. A micromechanical analysis was used. The analysis predicts the stress-strain response of the laminate and of the constituents in each ply during thermal and mechanical cycling by using only constituent properties as input. The fiber was modeled using a thermo-viscoplastic constitutive relation. The fiber transverse modulus was reduced in the analysis to simulate the fiber matrix interface failure. Excellent correlation was found between measured and predicted laminate stress-strain response due to generic hypersonic flight profile when fiber debonding was modeled. Author

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-25211# Westinghouse Savannah River Co., Aiken, SC.
REMOTE SENSING OF FRESHWATER AQUATIC MACROPHYTES IN A SOUTHEASTERN LAKE. PART 1: ANALYSIS OF 30 YEARS OF VERTICAL AERIAL PHOTOGRAPHY
J. R. Jensen (South Carolina Univ., Columbia.) and H. E. Mackey, Jr. 1991 10 p Presented at the 1991 ACSM/ASPRS (American Society for Photogrammetry and Remote Sensing) Annual Conference, Baltimore, MD, 25-29 Mar. 1991
(Contract DE-AC09-89SR-18035)
(DE92-009592; WSRC-MS-91-102; CONF-9103172-3) Avail: NTIS HC/MF A02

This paper summarizes the alternatives for conducting aquatic macrophyte mapping using in situ and remote sensing technologies, and then focuses on estimation of historical changes in persistent and non-persistent macrophyte beds in a large cooling lake in South Carolina from 1958 to 1990. Based on analysis of the historical aerial photography, rapid growth of the persistent beds of macrophytes along the shoreline did not begin until the early to mid-1970s and essentially stabilized by the late 1970s or early 1980s. Extensive growth of the non-persistent macrophytes began a few years after the persistent beds and, likewise, stabilized by the early 1980s. Comparisons of in situ and aerial photographic measurements indicate that large-scale, aerial photography can be used to accurately monitor lacustrine wetlands. Multidate photography is required if the lake is not successionally stable and if persistent and nonpersistent macrophyte beds occur, leading to large seasonal changes. DOE

N92-25248# Geological Survey of Canada, Ottawa (Ontario).
AGASSIZ METALLOTECT: APPLICATION OF MEIS-2 FOR BIOGEOCHEMICAL REMOTE SENSING AND GEOCHEMICAL EXPLORATION (LYNN LAKE, MANITOBA)
Vijay Singh, Wooil M. Moon, and Mark Fedikow (Department of Energy, Mines, and Resources, Winnipeg, Manitoba) Energy, Mines and Resources Canada May 1989 37 p
(CTN-91-60095) Copyright Avail: NTIS HC/MF A03

A remote sensing technique which can be applied in conjunction with a geobotanical approach to identify mineralized zones is investigated. The presence of toxic metals in soils is known to cause chlorotic leaves, stunted or oversized growth, abnormal blossoms or seeds, and other visible signs of poor health. The feasibility of airborne multidetector electro-optical imaging scanner (MEIS 2) and multispectral scanner (MSS) data was evaluated as a way to determine signs of vegetation stress, as well as their use as a potential biogeochemical exploration technique. An area in northern Manitoba known to contain banded iron formations and gold deposits was selected for study. During the study, soil fractions and vegetation specimens were chemically analyzed for the presence of eight metals. Airborne MEIS 2 and MSS data was collected for the area in June and August to determine the

effect of season on data collection. Fairly low correlation between the spectral data and the biogeochemical data was noted. A positive correlation was noted between band 2 of the MEIS 2 data and iron concentration, and bands 1 and 2 and copper concentration in the biogeochemical data. A number of factors other than metal ion concentration which influence the spectral reflectance response of the canopy were identified. CISTI

N92-25362 Politecnico di Milano (Italy). Dipartimento di Elettronica.
UNCERTAINTY MINIMIZATION IN THE LOCALIZATION OF POLYHEDRAL OBJECTS
Vincenzo Caglioti Jan. 1992 24 p
(Rept-92-002; ETN-92-91362) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A method for the determination of the optimum sensor exploration of a polyhedral object, whose geometry is known, is presented. Optimality is intended in the sense of the a posteriori covariance matrix of the object position and orientation parameters. The method consists of decomposing the problem onto simpler subproblems, each one relative to a single planar face of the object. The online processing time required for the minimization is comparable with the time normally due to the sensor activation. ESA

N92-25479# Pacific Northwest Lab., Richland, WA.
COMPARISONS OF SENSIBLE AND LATENT HEAT FLUXES USING SURFACE AND AIRCRAFT DATA OVER ADJACENT WET AND DRY SURFACES
J. C. Doran, J. M. Hubbe, W. J. Shaw, D. D. Baldocchi, T. L. Crawford, R. J. Dobosy, and T. J. Meyers Jan. 1992 15 p Presented at the 72nd American Meteorological Society Conference, Atlanta, GA, 5-10 Jan. 1992
(Contract DE-AC06-76RL-01830)
(DE92-006723; PNL-SA-20033; CONF-920134-6) Avail: NTIS HC/MF A03

In June 1991, a field study of surface fluxes of latent and sensible heat over heterogeneous surfaces was carried out near Boardman, Oregon (Doran et al., 1992). The object of the study was to develop improved methods of extrapolating from local measurements of fluxes to area-averaged values suitable for use in general circulation models (GCMs) applied to climate studies. A grid element in a GCM is likely to encompass regions whose fluxes vary significantly from one surface type to another. The problem of integrating these fluxes into a single, representative value for the whole element is not simple, and describing such a flux in terms of flux-gradient relationships, as is often done, presents additional difficulties. DOE

N92-25485# Lawrence Livermore National Lab., CA.
CONTINUOUS PROFILING OF MAGNETOTELLURIC FIELDS Ph.D. Thesis
C. T. Verdin May 1991 307 p
(Contract DE-AC03-76SF-00098)
(DE92-003897; LBL-31334) Avail: NTIS HC/MF A14

The magnetotelluric (MT) method of mapping ground electrical conductivity is traditionally based on measurement of the surface impedance at widely spaced stations to infer models of the subsurface through a suitable pseudo 1-D inverse or with linearized least-squares inversion for 2- or 3-D geoelectric media. It is well known that small near-surface inhomogeneities can produce spatial discontinuities in the measured electric fields over a wide frequency range and may consequently bias the impedance on a very local scale. Inadequate station spacing effectively aliases the electric field measurements and results in distortions that cannot be removed in subsequent processing or modelling. In order to fully exploit the benefits of magnetotellurics in complex geological environments, closely spaced measurements must be used routinely. This thesis entertains an analysis of MT data taken along continuous profiles and is a first step that will allow more encompassing 2-D sampling techniques to become viable in the years to come. The developments presented here are to a large extent motivated by the physical insight gained from low-contrast solutions to the forward MT problem. These solutions describe the relationship between a perturbation in the electrical conductivity of the subsurface and the ensuing perturbation of the MT response as the output of a linear system. Albeit strictly accurate in a limited subset of practical exploration problems, the linearized solutions allow one to pursue a model independent study of the response characteristics of MT data. In fact, these solutions yield simple expressions for 1-, 2-, and 3-D resistivity models which are here examined in progressive sequence. DOE

N92-25502# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Space Technology.
FOREST APPLICATIONS OF A HELICOPTER-BORNE 8-CHANNEL RANGING SCATTEROMETER
J. Hyyppae and M. Hallikainen Jul. 1991 22 p Sponsored by Suomen Akatemja, Helsinki
(PB92-141985; ISBN-951-22-0734-6; Rept-5) Avail: NTIS HC/MF A03

A novel helicopter borne 8-channel ranging scatterometer, HUTSCAT, was used to investigate the backscattering behavior of forest canopies at 5.4 GHz and 9.8 GHz. The HUTSCAT output products were used in order to determine the location of backscattering sources, measure the mean and dominant tree height, estimate timber volume, determine the crown base, and classify different tree species. Author

N92-25573 North Carolina State Univ., Raleigh.
NATURAL SCENE DESCRIPTION BASED ON FRACTAL FEATURES Ph.D. Thesis
Horng-Hai Loh 1991 115 p
Avail: Univ. Microfilms Order No. DA9208916

The objective of this research is to develop a new 'knowledge based' image description system using fractal features. We incorporate a 'knowledge based' recognition process into this image description system to provide us with the capability of natural scene understanding. In this dissertation, the structure of this system and its interaction strategy for the extraction of scene description are also presented with experimental results. This research is divided into three phases: fractal feature development, image segmentation with fractal features, and 'knowledge based' scene description. First, a novel fractal model is developed to efficiently extract fractal features from the natural image. We use fractal features to represent the texture characteristics of natural surfaces. Second, we develop a image segmentation algorithm which can segment natural images into regions using the developed fractal features. We also conduct a number of texture classification experiments in this phase to demonstrate the capability of these fractal features. Third, a 'knowledge based' scene recognition process is used to describe natural images through the interaction between the knowledge base and the system. An extensive survey of previous work in this area and its relative advantages/disadvantages has been included in this dissertation. Dissert. Abstr.

N92-25612*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
MICROWAVE RADIOMETER STUDIES OF ATMOSPHERIC WATER OVER THE OCEANS, VOLUME 1
Kristina B. Katsaros Mar. 1992 120 p
(Grant NAG5-943)
(NASA-CR-190342; NAS 1.26:190342) Avail: NTIS HC/MF A06

Since Seasat carried the Scanning Multichannel Microwave Radiometer (SMMR) into space, shortly followed by the SMMR on Nimbus 7, a new type of data source on atmospheric water vapor and other meteorological parameters has been available for analysis of weather systems over the ocean. Since 1987, the Scanning Multichannel Microwave/Imager (SMM/I) has provided similar data. A collection of work using this data is presented. For individual titles, see N92-25613 through N92-25614.

N92-25613*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
SATELLITE-DERIVED SURFACE LATENT HEAT FLUXES IN A RAPIDLY INTENSIFYING MARINE CYCLONE **c47**
Douglas K. Miller and Kristina B. Katsaros *In its* Microwave Radiometer Studies of Atmospheric Water Over the Oceans, Volume 1 Mar. 1992 p 1-40 (For primary document see N92-25612 16-43)
Avail: NTIS HC/MF A06

Surface latent heat fluxes are estimated in the vicinity of a rapidly deepening cyclone before and during its period of most rapid intensification. This was done with a bulk parameterization scheme and remotely sensed input data. A method is studied for estimating the difference in specific humidity between the surface and a ten meter height using the Special Sensor Microwave/Imager (SSM/I) observed integrated water vapor field and a sea surface temperature analysis. The surface latent heat flux fields generally have estimated errors below 40 pct. south of 40 deg. N and outside the region of high integrated water vapor values associated with frontal bands. The method of estimating surface latent heat fluxes for the case study was found to be usable in most regions of the Northwest Atlantic Ocean except for those locations directly adjacent to coastlines in instances of offshore flow and in the vicinity of surface fronts. Author

N92-25614*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
A COLD AIR OUTBREAK OVER THE NORWEGIAN SEA OBSERVED WITH THE TIROS-N OPERATIONAL VERTICAL SOUNDER (TOVS) AND THE SPECIAL SENSOR MICROWAVE/IMAGER (SSM/I) **c47**
Chantal Claud, Kristina B. Katsaros, Grant W. Petty, Alain Chedin, and Noelle A. Scott (Ecole Polytechnique, Palaiseau, France) *In its* Microwave Radiometer Studies of Atmospheric Water Over the Oceans, Volume 1 Mar. 1992 p 41-81 (For primary document see N92-25612 16-43)
Avail: NTIS HC/MF A06

Until recently, the scarcity of meteorological observations over polar areas has limited studies of high latitude weather systems, but now data from polar orbiting satellites offer a new opportunity to observe and describe these systems. TOVS data were used successfully for delineating synoptic and subsynoptic systems since they provide the vertical temperature structure of the atmosphere: SSM/I observations have proved valuable for analyzing storms through water vapor and rain determinations. These positive results prompted us to analyze simultaneous TOVS and SSM/I observations obtained during a cold air outbreak over the Norwegian Sea. After a description of the instruments and the retrieval schemes, the mutually supporting information from these two independent instruments is discussed. Implications for the monitoring of polar lows are presented. Author

N92-25620# National Space Development Agency, Tokyo (Japan).
INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: JERS-1 WORKSHOP
2 Nov. 1990 158 p In ENGLISH and JAPANESE Conference held in Ibaraki, Japan, 2 Nov. 1990
(JTN-92-80346) Avail: NTIS HC/MF A08

The following topics were discussed: JERS-1 (Japanese Earth Resources Satellite-1), JERS-1 satellite verification program, remote sensing, remote sensors, earth resources survey, ice observation, SAR (Synthetic Aperture Radar), optical sensors, radiometers, ground stations, mission planning procedure, data acquisition, data reception, data processing, data transfer network, data distribution, JERS-1 data cataloging and archiving, JERS-1 project organization, and schedule of project. For individual titles, see N92-25621 through N92-25635.

N92-25621# National Space Development Agency, Tokyo (Japan). Earth Observation Satellite Group.
DEVELOPMENT STATUS OF SPACE CRAFT **c18**
Chu Ishida *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 1-6 (For primary document see N92-25620 16-43)
(EW-1) Avail: NTIS HC/MF A08

Presented in viewgraph format, the status of JERS-1 (Japan Earth Resources Satellite-1) development is outlined. Topics addressed include: JERS-1 project organization; JERS-1 development schedule; design parameters such as orbit category, altitude, inclination, period, recurrent period, local mean time; on orbit configuration of JERS-1; and satellite components such as mission instrument system and satellite bus system e.g., Synthetic Aperture Radar (SAR), and Communications and Data Handling Subsystem (C&DH). Author (NASDA)

N92-25622# Japan Resources Observation System Organization.
SAR DEVELOPMENT STATUS **c32**
Yukiaki Nemoto *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 7-18 (For primary document see N92-25620 16-43)
(EW-2) Avail: NTIS HC/MF A08

Presented in viewgraph format, the status of SAR (Synthetic Aperture Radar) development on the JERS-1 (Japan Earth Resources Satellite-1) are described. Topics addressed include: block diagram of SAR; functional block diagram of signal processor; specification of SAR; SAR data sequence; radar calibration; SAR raw data format at observation mode and calibration mode; and schedules of SAR development. Author (NASDA)

N92-25623# Japan Resources Observation System Organization.
DEVELOPMENT STATUS OF JERS-1 OPTICAL SENSOR SYSTEM **c74**
Hiromi Ono *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 19-28 (For primary document see N92-25620 16-43)
(EW-3) Avail: NTIS HC/MF A08

Presented in viewgraph format, the status of optical sensor system development for JERS-1 (Japan Earth Resources Satellite-1) is outlined. Topics addressed include: specification of OPS (Optical Sensor); block diagram of JERS-1 OPS; configuration of OPS; system of stereoscopic imaging; configuration of VNIR (Visible and Near-Infrared Radiometer); CCD (Charge Coupled Device) sensor; configuration of SWIR (Short Wave Infrared Radiometer); and development schedules. Author (NASDA)

N92-25624# National Space Development Agency, Ohashi (Japan). ERS-1 Payload Ground Segment Office.
ERS-1 FACILITY AT EARTH OBSERVATION CENTER **c14**
Hiroyuki Wakabayashi *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 29-40 (For primary document see N92-25620 16-43)
(EW-4) Avail: NTIS HC/MF A08

Presented in viewgraph format, the status and overview of JERS-1 (Japan Earth Resources Satellite-1) ground system are outlined. Topics addressed include: purposes and functions of JERS-1 ground system; system overview; development schedule; functional block diagram of JERS-1 ground system; ground station; data receiving system; data recording system; data processing system; quality of JERS-1 data; and flow of SAR (Synthetic Aperture Radar) data processing. Author (NASDA)

N92-25625# National Space Development Agency, Ohashi (Japan).
MISSION PLANNING PROCEDURE
Takeshi Nagai and Ichiroh Naitoh *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 41-53 (For primary document see N92-25620 16-43)
(EW-5) Avail: NTIS HC/MF A08

Presented in viewgraph format, major tasks and characteristics of mission planning for JERS-1 (Japan Earth Resources Satellite-1), and user interface of JERS-1 are outlined. Topics addressed include: work flow of JERS-1 operation planning; major operation

constraint of mission equipments; primary objective of data acquisition; observation request; catalogue information retrieval; data request; and data system for JERS-1 data distribution.
Author (NASDA)

N92-25626# National Space Development Agency, Ohashi (Japan).
VERIFICATION PROJECT
Korehiro Maeda *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 55-70 (For primary document see N92-25620 16-43)
(EW-6) Avail: NTIS HC/MF A08

Presented in viewgraph format, verification activities of JERS-1 (Japan Earth Resources Satellite-1) in NASDA (National Space Development Agency of Japan) are outlined. Topics addressed include: mission objectives of JERS-1 system; purpose of JERS-1 verification program; schedule of verification program; verification items; calibration of SAR (Synthetic Aperture Radar) on the JERS-1; and calibration of OPS (Optical Sensor) system on the JERS-1.
Author (NASDA)

N92-25627# Alaska Synthetic Aperature Radar Facility, Fairbanks.
ALASKA SAR FACILITY **c14**
John Miller *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 71-81 (For primary document see N92-25620 16-43)
(EW-7) Avail: NTIS HC/MF A08

Presented in viewgraph format, the data system of ASF (Alaska Synthetic Aperture Radar Facility) in the U.D. is outlined. Topics addressed include: functional block diagram of ASF and its mission planning subsystem; SAR (Synthetic Aperture Radar) data processing system of ASF; system architecture of SPS (SAR Processor System); ASF data products; geophysical data processing system; ice motion tracking system; and image analysis system.
Author (NASDA)

N92-25628# Canada Centre for Remote Sensing, Ottawa (Ontario). Data Acquisition Div.
STATUS OF CANADIAN GROUND STATIONS **c14**
Leon Bronstein *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 83-90 (For primary document see N92-25620 16-43)
(EW-8(1)) Avail: NTIS HC/MF A08

Presented in viewgraph format, ground stations of CCRS (Canada Centre for Remote Sensing) in Canada are introduced. Topics addressed include: functional block diagram of Canadian ERS-1 ground segment; data acquisition facilities; data transfer network; SAR (Synthetic Aperture Radar) data processing facility; satellite systems and operations of CCRS; plans of satellite signal reception in CCRS; and plans of JERS-1 (Japan Earth Resources Satellite-1) data processing.
Author (NASDA)

N92-25629# Canada Centre for Remote Sensing, Ottawa (Ontario).
JERS-1 DATA APPLICATIONS IN CANADA
Leon Bronstein *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 91-95 (For primary document see N92-25620 16-43)
(EW-8(2)) Avail: NTIS HC/MF A08

Presented in viewgraph format, an outline of Canadian earth observation programs utilizing JERS-1 (Japan Earth Resources Satellite-1) is described. Topics addressed include: coverage circles of observation from Prince Albert and Gatineau Satellite Stations; observation using CV-580 aircraft; utilization of data sets acquired from other satellites, ground scatterometer, airborne electrooptical imagery, and test sites; Canadian experiment teams; JERS-1 announcement of opportunity (A-O) and its options; Canadian A-O data requirement; and commercial access to JERS-1 data.
Author (NASDA)

N92-25630# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.
EUROPEAN SPACE AGENCY J-ERS1 STATUS
Vincent Beruti *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 97-100 (For primary document see N92-25620 16-43)
(EW-9) Avail: NTIS HC/MF A08

Presented in viewgraph format, status of ESA's (European Space Agency) activity in JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 is mentioned. Topics addressed include: memorandum of understanding between ESA and NASDA (National Space Development Agency of Japan); and JERS-1 upgrading status.
Author (NASDA)

N92-25631# National Research Council, Bangkok (Thailand).
JERS-1 WORKSHOP ON THE GROUND STATION FOR ASEAN **c14**
Chanchai Peanvijarnpong *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 101-11 (For primary document see N92-25620 16-43)
(EW-10) Avail: NTIS HC/MF A08

Presented in viewgraph format, the present status of the ground station and future plan for utilizing earth observation satellites in Thailand is outlined. Topics addressed include: data acquisition system; operation status of LANDSAT, SPOT, and MOS-1 (Marine Observation Satellite-1); remote sensors of satellites; data output form; data correction level; data system in Thailand; ground station for MOS-1 satellite in Thailand; and future plan. Author (NASDA)

N92-25632# Tokai Univ., Tokyo (Japan). Research and Information Center.
UTILIZATION OF JERS-1 DATA
Haruhisa Shimoda *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 113-11 (For primary document see N92-25620 16-43)
(EW-11) Avail: NTIS HC/MF A08

Presented in viewgraph format, the reception and use of JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 data is outlined. Topics addressed include: performance of JERS-1 and its sensor units; utilization of JERS-1 and ERS-1 data; land cover classification; vegetation classification; change detection; ocean observation; soil moisture detection; natural hazard detection; stereo image; and Synthetic Aperture Radar (SAR).
Author (NASDA)

N92-25633# National Inst. of Polar Research, Tokyo (Japan).
JERS-1 APPLICATION FOR SEA ICE, GLACIER, AND ICE SHEET
Fumihiko Nishio *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 119-14 (For primary document see N92-25620 16-43)
(EW-12) Avail: NTIS HC/MF A08

Presented in viewgraph format, application of JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 data to observe sea ice, glacier and ice sheet is presented. Topics addressed include: operational status of world earth observation satellites; SAR (Synthetic Aperture Radar) data requirement; characteristics of Optical Sensor (OPS) and SAR on the JERS-1; usefulness of SAR and other sensors compared under the glaciological regime; and sensor images of ice environment.
Author (NASDA)

N92-25634# Earth Resources Satellite Data Analysis Center, Tokyo (Japan).
UTILIZATION OF SAR DATA FOR RESOURCES EXPLORATION
Atsushi Iwashita *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 141-15 In ENGLISH and JAPANESE (For primary document see N92-25620 16-43)
(EW-13) Avail: NTIS HC/MF A08

Presented in viewgraph format, utilization of Synthetic Aperture

Radar (SAR) data for geological survey is outlined. Topics addressed include: analysis of SAR image over the tropical forest; edge density image; terrain detection; and rock type discrimination. Author (NASDA)

N92-25635# Geological Survey of Japan, Ibaraki.
UTILIZATION OF OPS DATA FOR RESOURCES EXPLORATION
Ryouichi Kouda *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 153-17 (For primary document see N92-25620 16-43)
(EW-14) Avail: NTIS HC/MF A08

Presented in viewgraph format, utilization of OPS (Optical Sensor) for geological survey is outlined. Topics addressed include: outline of data processing and analysis procedures for ASEAN (Association of Southeast Asian Nations) remote sensing Indonesian project; mineral exploration; edge detecting operators; rock type discrimination; geologic map; geologic mapping; phase diagram; gravity measurement; and gold deposits.
Author (NASDA)

N92-25692# National Space Development Agency, Tokyo (Japan).
INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: ADEOS WORKSHOP
30 Oct. 1990 218 p Conference held in Ibaraki, Japan, 30 Oct. 1990
(JTN-92-80343) Avail: NTIS HC/MF A10

Topics addressed include: outlines and status of the ADEOS (Advanced Earth Observing Satellite) Project, IMG (Interferometric Monitor for Greenhouse Gases) Project, ILAS (Improved Limb Atmospheric Spectrometer) Project, RIS (Retroreflector In-Space) Project, NSCAT (NASA Scatterometer) Project, TOMS (Total Ozone Mapping Spectrometer) Project, POLDER (Polarization and Directionality of the Earth's Reflectances) Project, AVNIR (Advanced Visible and Near Infrared Radiometer) Project, and OCTS (Ocean Color and Temperature Scanner) Project. An outline of ADEOS mission, NSCAT mission, POLDER/OCTS mission, and IMG mission, and the research plan for each sensor are also presented. For individual titles, see N92-25693 through N92-25708.

N92-25693# National Space Development Agency, Tokyo (Japan). Earth Observation Satellite Group.
STATUS OF ADEOS PROJECT
Nobuo Iwasaki *In its* International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 9-18 (For primary document see N92-25692 16-43)
(AW-2) Avail: NTIS HC/MF A10

The ADEOS (Advanced Earth Observing Satellite) is a large earth observing satellite which carries two core sensors and six announce of opportunity (AO) sensors. The objectives of these sensors are global observation of land, ocean, and atmosphere. ADEOS has another mission to develop some technology required for the future platform era. Inter-Orbit Link (IOL) is one of them and will be established between ADEOS and ETS-6 (Engineering Test Satellite-6) for the first time in Japan, experimentally. After launching of the Communication and Broadcasting Engineering Satellites, all of the observation data of ADEOS will be transmitted by the IOL as a real time basis, demonstrating that IOL is a key technology for future platform era. ADEOS accommodatesthe conventional and reliable X band system also for the direct mission data transmission to the ground station. The science data from these sensors are properly multiplexed and recorded efficiently in the ADEOS to secure the global coverage. ADEOS is scheduled to be launched early 1995 by the H-2 launch vehicle from Tanegashima Space Center. NASDA (National Space Development Agency of Japan) has just started the ADEOS Phase C study.
Author (NASDA)

N92-25694# National Research Lab. of Metrology, Tokyo (Japan).
STATUS OF IMG PROJECT
Akira Ono *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 19-29 (For primary document see N92-25692 16-43)
(AW-3) Avail: NTIS HC/MF A10

The mission objectives and status of the IMG (Interferometric Monitor for Greenhouse Gases) Project for ADEOS (Advanced Earth Observing Satellite) are outlined in viewgraph form. The topics addressed include: mission requirements and configuration of IMG; IMC (Image Motion Compensation); FOV (Field of View); ADEOS path, development schedule of IMG; management system; and design concept. Author (NASDA)

N92-25695# National Inst. for Environmental Studies, Ibaraki (Japan). Global Environmental Dept.
STATUS OF ILAS/RIS PROJECT
Yasuhiro Sasano and Kazuya Asada *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 31-48 (For primary document see N92-25692 16-43)
(AW-4) Avail: NTIS HC/MF A10

The mission objectives and status of ILAS (Improved Limb Atmospheric Spectrometer) and RIS (Retroreflector In Space) project for ADEOS (Advanced Earth Observing Satellite) are outlined in viewgraph form. The topics addressed include: background and objective of development for the ozone monitoring sensor; principle and function of ILAS and RIS unit; specifications of both the unit; development schedule; and ground station.
Author (NASDA)

N92-25696*# National Aeronautics and Space Administration, Washington, DC.
STATUS OF NSCAT/TOMS PROJECT
G. F. Esenwein *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 49-53 (For primary document see N92-25692 16-43)
(AW-5) Avail: NTIS HC/MF A10

The status of the NSCAT (NASA Scatterometer) and TOMS (Total Ozone Mapping Spectrometer) Projects for the ADEOS (Advanced Earth Observing Satellite) which were developed as part of NASA Earth Probes Program are outlined in viewgraph form. The topics addressed include: objectives of NSCAT and TOMS sensor development; specifications of sensors; utilization of sensors for NIMBUS-7 satellite, ADEOS, and NROSS (Navy Remote Ocean Sensing System) satellite; and the status of PDR (preliminary design review) and CDR (critical design review) for sensors. Author (NASDA)

N92-25697# Centre National d'Etudes Spatiales, Paris (France).
STATUS OF POLDER PROJECT
Jean Pierre Deshayes *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 55-65 (For primary document see N92-25692 16-43)
(AW-6) Avail: NTIS HC/MF A10

The result of the Phase A study and the plan of the Phase B study for the ADEOS (Advanced Earth Observing Satellite) POLDER (Polarization and Directionality of the Earth's Reflectances) Project were described. The topics addressed include: an outline of POLDER; explanation of investigation fields utilizing POLDER; schedule of development; specifications; system architecture; principles of measurement; preliminary configuration; data processing center; conclusion of Phase A study; and decisions for Phase B study. Author (NASDA)

N92-25698# National Space Development Agency, Tokyo (Japan). Earth Observation Program Office.
ACTIVITY OF ADEOS MISSION TEAM
Kazuo Tachi *In its* International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 67-73 (For primary document see N92-25692 16-43)
(AW-7) Avail: NTIS HC/MF A10

In 1989, NASDA (National Space Development Agency of Japan) set up the ADEOS (Advanced Earth Observing Satellite)

data set study team chaired by Dr. Hirosawa, Institute of Space and Science in order to survey ADEOS data requirements and to study algorithms to obtain geophysical variables. This year, NASDA has organized the ADEOS Mission Teams composed of scientists. The objectives of the ADEOS Mission Teams are to make algorithms to produce final data set to make an instrument verification and validation plan, and to make a mission operation plan. Each mission team is primarily organized by the respective instrument provider or the sponsoring agency. NASDA will organize the Mission Coordination Board (MCB) to integrate the mission teams plans, coordinate intercalibration between instruments, to emphasize interdisciplinary study activity, and to promote ADEOS data use. Author (NASDA)

N92-25699# Remote Sensing Technology Center, Tokyo (Japan).
DATA APPLICATION OF AVNIR
Hajime Koshiishi *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 75-83 (For primary document see N92-25692 16-43)
(AW-8) Avail: NTIS HC/MF A10

The scientific features of AVNIR (Advanced Visible and Near Infrared Radiometer) sensor for the ADEOS (Advanced Earth Observing Satellite) and the mission of the AVNIR team are described. The mission is composed of a sensor performance study, an application study, an investigation on products, and a supporting study for the verification program. Expected data applications are the estimation of wave over sea and hydrology and vegetation. The topics addressed include: outline and characteristics of the AVNIR sensor; spatial resolution; image quality; radiometric performance; geometric distortion; stereoscopic performance; atmospheric effect on sensor performance; expected application study using sensor; investigation of products from AVNIR data; and the mission of the AVNIR study team.
Author (NASDA)

N92-25700# Far Seas Fisheries Research Lab., Shimizu (Japan).
DATA UTILIZATION PROGRAM OF ADEOS OCTS
Satsuki Matsumura *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 85-93 (For primary document see N92-25692 16-43)
(AW-9) Avail: NTIS HC/MF A10

The purpose of OCTS (Ocean Color and Temperature Scanner) mission team and applications of the ocean color data are described in viewgraph form. The topics addressed include: the main purpose and the activity of OCTS mission team; user's target; application of ocean color data such as global scale studies of biogeochemical cycles, fisheries application, coupling of ocean color data with ecosystem models, and coastal environment study; data transmission; and requirements for sensor data quality.
Author (NASDA)

N92-25701# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NASA SCATTEROMETER (NSCAT): DATA APPLICATION AND SCIENTIFIC CHALLENGES
Michael H. Freilich *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 95-109 (For primary document see N92-25692 16-43)
(AW-10) Avail: NTIS HC/MF A10

The application of NSCAT (NASA Scatterometer) data to ocean wind measurement is described in viewgraph form. The topics addressed include: scientific need and challenges for ocean wind measurement; examples of science investigations utilizing NSCAT; and outlines of investigations conducted by NASA NSCAT Science Team. Author (NASDA)

N92-25702# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
START OF THE ADEOS-NSCAT MISSION TEAM IN JAPAN
Harunobu Masuko *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 111-125 (For primary document see N92-25692 16-43)
(AW-11) Avail: NTIS HC/MF A10

The issues of satellite scatterometry, related research, and requirements for NSCAT (NASA Scatterometer) data in Japan are described, and the Japanese NSCAT Mission Team and its principal purpose are introduced. The topics are addressed in viewgraph form and include: role of wind over the ocean in earth environment; wind scatterometry; wind speed measurement; principal purpose and member list for the Japanese ADEOS (Advanced Earth Observing Satellite) NSCAT Mission Team; utilization requirements of ADEOS-NSCAT data; requirements for data sets such as the signal level, resolution, quality, data distribution, and software; and the ocean experiment in the JERS-1 (Japan Earth Resources Satellite-1) Program. Author (NASDA)

N92-25703*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TOMS SCIENCE OBJECTIVES AND PROJECT STATUS
A. Krueger *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 127-143 (For primary document see N92-25692 16-43)
(AW-12) Avail: NTIS HC/MF A10

The status of the TOMS (Total Ozone Mapping Spectrometer) Project is outlined in viewgraph form with emphasis on its data application to science. The topics addressed include: primary scientific goals of TOMS application; ozone research activities; volcano-climate research; total ozone trends; polar ozone changes; TOMS flight status; interim missions; contract status of ADEOS (Advanced Earth Observing Satellite) TOMS development; configuration of TOMS; and the result from NIMBUS-7 observation. Author (NASDA)

N92-25704# Tokyo Univ. (Japan). Geophysics Research Lab.
SCIENTIFIC PRODUCTS EXPECTED FROM THE TOMS DATA
Toshihiro Ogawa *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 145-152 (For primary document see N92-25692 16-43)
(AW-13) Avail: NTIS HC/MF A10

The expected scientific products from the ADEOS (Advanced Earth Observing Satellite) TOMS (Total Ozone Mapping Spectrometer) data are presented in viewgraph form. The topics addressed include: global mapping of total ozone; global mapping of total sulfur dioxide; and global mapping of tropospheric ozone.
Author (NASDA)

N92-25705# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
POLDER DATA APPLICATION
Pierre Y. Deschamps *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 153-166 (For primary document see N92-25692 16-43)
(AW-14) Avail: NTIS HC/MF A10

The expected applications of the ADEOS (Advanced Earth Observing Satellite) POLDER (Polarization and Directionality of the Earth's Reflectances) data are presented in viewgraph form. The topics addressed include: global survey of the biosphere and the atmosphere; ocean color observation; vegetation index; aerosols observation; radiative budget; clouds observation; water vapor content; schedule of POLDER products; and sensor calibration.
Author (NASDA)

N92-25706# Meteorological Research Inst., Tsukuba (Japan).
POLDER/OCTS MISSION TEAM
Tsutomu Takashima *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30

Oct. 1990 p 167-195 (For primary document see N92-25692 16-43)
(AW-15) Avail: NTIS HC/MF A10

The polarization measurement is presented in viewgraph form with attention on the atmosphere and ocean system. The topics addressed include: objectives of the polarization measurement; the principle of the polarization measurement; the POLDER (Polarization and Directionality of the Earth's Reflectances) OCTS (Ocean Color and Temperature Scanner) research plan; outlines of polarization measurement conducted before; aerosol observation; phase function and polarization; radiance and polarization degree; and dependence of the radiation just above and below the ocean surface on atmospheric and oceanographic parameters. Author (NASDA)

N92-25707# Tokai Univ., Tokyo (Japan). Research and Information Center.
IMG MISSION TEAM
Haruhisa Shimoda *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 197-219 (For primary document see N92-25692 16-43)
(AW-16) Avail: NTIS HC/MF A10

Outlines of the IMG (Interferometric Monitor for Greenhouse Gases) Project for the ADEOS (Advanced Earth Observing Satellite) and responsibilities of IMG Mission Team are presented in viewgraph form. The topics addressed include: mission objectives such as high accuracy measurement of earth radiation budget, high accuracy measurement of temperature profiles, measurements of density profiles of CO2 and H2O, total ozone observation, and mixing ratio of CH4, N2O, and CO inthe troposphere; specifications of the IMG such as spectral range, wave number resolution, wave number accuracy, S/N (Signal to Noise) ratio, absolute accuracy, stability, and so on; the IMG mission team responsibilities; outline of the IMG Science and Data Information System; mission operation and standard products of IMG; data quantity; and explanation of FT-IR (Fourier Transformation Infrared) spectroscopy and its utilization in the field of science. Author (NASDA)

N92-25708# National Inst. for Environmental Studies, Tsukuba (Japan).
ILAS/RIS RESEARCH PLANS: DATA APPLICATION
Yasuhiro Sasano *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop 30 Oct. 1990 p 221-244 (For primary document see N92-25692 16-43)
(AW-17) Avail: NTIS HC/MF A10

The principle and the purpose of the ILAS (Improved Limb Atmospheric Spectrometer) and RIS (Retroreflector In-Space) measurements are outlined in viewgraph form. The topics addressed include: the principle of the ILAS/RIS measurement; utilization of ILAS/RIS data; ILAS/RIS data retrieval; data level of the ILAS/RIS; framework of the ILAS data management; structure of the RIS reflector; ground station for RIS measurement; and introduction of the Center for Global Environmental Research (CGER) of Japan established on October 1990 at the NIES (National Institute for Environmental Studies). Author (NASDA)

N92-26046# National Space Development Agency, Tokyo (Japan).
INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: SYMPOSIUM ON MOS-1 DATA EVALUATION
31 Oct. 1990 426 p Conference held in Ibaraki, Japan, 31 Oct. 1990
(JTN-92-80344) Avail: NTIS HC/MF A19

The following topics were discussed: specifications and performance of MOS-1b (Marine Observation Satellite-1b) components and onboard sensors; evaluation of sensors and its subsystem; evaluation of sensor data; image calibration; MSR (Microwave Scanning Radiometer); VTIR (Visible and Thermal Infrared Radiometer); MESSR (Multispectral Electronic Self-Scanning Radiometer); MTF (Modulation Transfer Function); utilization of MOS-1 sensor data; vegetative index; forestry management; land management; flood mapping; sea surface temperature; atmospheric sounding; application for oceanography, fisheries, and meteorology; and disaster prevention. All of the presentations are represented by viewgraphs only. For individual titles, see N92-26047 through N92-26071.

N92-26047# National Space Development Agency, Tokyo (Japan).
RESULT OF MOS-1b CHECKOUT
Ryota Sato and Masato Takahashi *In its* International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 7-28 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

This paper summarizes the result of MOS-1b (Marine Observation Satellite-1b) checkout. MOS-1b was launched from Tanegashima Space Center, NASDA (National Space Development Agency of Japan) by H-1 launch vehicle on February 7, 1990. Within two days, three-axis attitude was established. During the succeeding two months, the orbital performance of mission and bus subsystems was thoroughly checked out. The result of this checkout showed that the satellite performed satisfactorily. The presentation is in viewgraphs only. Author (NASDA)

N92-26048# National Space Development Agency, Ohashi (Japan).
OUTLINE OF MOS-1b COMPATIBILITY RESULTS
I. Naito *In its* International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 29-38 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

National Space Development Agency of Japan (NASDA) launched Marine Observation Satellite-1 (MOS-1) completely on February 7, 1990. This report presents the results of the evaluation of MOS-1b processed image data. The accuracy of MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) distortion correction are evaluated by using satellite data. The above evaluations were accomplished satisfactorily, and the obtained results were concluded to be quite practical for the continuing progress of the operations of MOS data processing system. Author (NASDA)

N92-26049# National Space Development Agency, Ohashi (Japan). Earth Observation Center.
OUTLINE OF MOS-1 DATA EVALUATION
Korehiro Maeda *In its* International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 39-50 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Marine Observation Satellite-1 (MOS-1) and MOS-1b were launched in 1987 and 1990, respectively. MOS-1 data are now received by 11 ground stations in the world. NASDA (National Space Development Agency of Japan) conducted MOS-1 Verification Program (MVP) in collaboration with domestic and foreign investigators in order to evaluate MOS-1 observations from various points of view. As a part of MVP, the utility of MOS-1 data in various application fields including earth environment has been evaluated. In 1989 FY (Fiscal Year), NASDA conducted MOS-1 evaluation with 20 domestic organizations. NASDA is also developing MOS-1 data set for both sea surface temperature and polar ice to prepare for ISY (International Space Year: 1992) in collaboration with related research organizations and plans to distribute to domestic organizations the MOS-1/MOS-1b data set for study. Fields of utilization are classified into three categories (ocean, land and atmosphere) and outline of evaluation results of MOS-1 data are presented. Author (NASDA)

N92-26050# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION Report No. 3
Masao Takabe, Toshikazu Itabe, and Tadashi Aruga *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 51-65 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

An earth laser beam observed from space looks like a point similar to a bright star. Thus the spot image of a laser beam is very useful for calibration and correction of an earth's surface image taken by optical radiometers or cameras, since it corresponds to an infinitively small landmark whose absolute location and brightness are known precisely. Experiments were conducted that track the MOS-1 (Marine Observation Satellite-1) satellite and transmit a laser beam from a ground station at CRL (Communications Research Laboratory) to the satellite. Currently an argon ion laser is used as the beacon and the images taken by the MESSR (Multispectral Electronic Self-Scanning Radiometer) are analyzed for this study. As the results of analyses, first the tendency of the MOS-1 location error obtained from optical tracking is shown. Then the geometric error of the MESSR earth images and the satellite's attitude estimated from two dimensional coordinates of the laser spot and the scene center, are shown.
Author (NASDA)

N92-26051# Ministry of Posts and Telecommunications, Kashima (Japan). Space Research Center.
MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR
Yuji Ohsaki and Masaharu Fujita *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 67-92 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

A comparison is performed of rain rates retrieved from MSR (Microwave Scanning Radiometer) brightness temperature and those obtained from Satellite-derived Index of Precipitation Intensity (SI). SI is designed to estimate the rain rates from GMS (Geostationary Meteorological Satellite) measurements by Meteorological Satellite Center of Japan Meteorological Agency. Good correlation between these measurements is found. It is also found that the rain height is a key parameter for the measurement of rain rate with better accuracy than satellite-borne radiometer and that SI will be very useful to clarify the potential of rain measurements with a new microwave radiometer, such as the Special Sensor Microwave Imager. Author (NASDA)

N92-26052# Meteorological Research Inst., Tsukuba (Japan). Meteorological Satellite and Observation Research Div.
CALIBRATION AND UTILIZATION OF VTIR
Yozo Takayama *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 93-109 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

To evaluate the quality of CH (Channel) 2 data, the brightness temperature (radiance spectrally averaged over weighting functions by filter transmittance distribution function) of CH 2 in a clear region is compared with calculated brightness temperature obtained by radiative transfer code and aerological data with the assumption of water vapor distributions in upper troposphere and stratosphere, and with consideration of radiosonde measurement error in relative humidity. The comparison suggests that both brightness temperatures agreed within the margin of error in relative humidity of radiosonde measurement. In the infrared spectral channels, it is concluded that VTIR (Visible and Thermal Infrared Radiometer) on MOS-1 (Marine Observation Satellite-1) satellite makes measurement of upwelling radiation sufficiently well. As an application of VTIR data to meteorology, sea surface temperature retrieval is examined and CH 2 data in clear area is analyzed. The root mean square temperature differences of sea surface temperature are 0.89 C for three channels algorithm, and 1.00 C for two channels algorithm, respectively. From the result of analysis of CH 2 data by using radiosonde data, in no aerological data area, it may be feasible to improve accuracy in an analysis of water vapor distribution used as an initial value for numerical weather forecast. Author (NASDA)

N92-26053# Meteorological Research Inst., Tsukuba (Japan).
STUDY OF ADVANCED MICROWAVE SCANNING RADIOMETER BASED ON RESULTS OF MSR ABOARD MOS-1
Akira Shibata, Korehiro Maeda, and Yuji Osawa *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 111-128 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Verification experiments of Microwave Scanning Radiometer (MSR) aboard Marine Observation Satellite-1 (MOS-1) launched in February 1987 show that MSR is capable of observing column water vapor over the ocean with an accuracy of 2 to 3 kg/sq m in the range between 5 and 60 kg/sq m. The observation is interrupted under rainy conditions, because the microwave is scattered by rain drop and ice crystal. A criterion for accurate observation is roughly determined that column liquid water is less than 0.8 kg/sq m, which may correspond to precipitation of a few millimeter per hour. Even though MSR has attained the performance determined at the design stage, it is revealed that MSR has several disadvantages. Therefore, advanced MSR which overcomes the disadvantages is presented. Author (NASDA)

N92-26054# Tokai Univ., Tokyo (Japan). Research and Information Center.
ESTIMATION OF MTF OF MOS-1 MESSR IMAGES
Toshibumi Sakata, Haruhisa Shimoda, and Kiyonari Fukue *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 129-153 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

An MTF (Modulation Transfer Function) of MESSR (Multispectral Electronic Self-Scanning Radiometer) image was estimated using an edge spectrum ratio method. This method was applied to vertical and horizontal edges in several MESSR images. The Effective Instantaneous Field of View (EIFOV) was obtained from the estimated MTF. The average values of obtained EIFOV's are 71 to 75 m and 77 to 78 m for tracking and scanning directions, respectively. As the result of evaluation for EIFOV's, the following conclusions were obtained: (1) Seasonal changes of atmospheric condition affect on EIFOV about 4 m as average and about 10 m as maximum; (2) A difference of EIFOV between the system-1 and 2 is 0; (3) Atmospheric effects on EIFOV were estimated as 29, 24, 21, and 11 m for each channel, respectively. But large variations of EIFOV among channels are not observed on images so that atmospheric effects and intrinsic performances of MESSR cancel each other; and (4) It is estimated after consideration of intrinsic performance of MESSR that the movement of platform increases 14 m (15 pct.) of EIFOV. Author (NASDA)

N92-26055# Ministry of Agriculture, Forestry, and Fisheries, Ibaraki (Japan). Remote Sensing Lab.
CHARACTERISTICS OF MOS-1 MESSR IMAGE IN FOREST AREA
Haruo Sawada, Osamu Nakakita, Gen Takao, and Yoshio Awaya *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 155-172 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

An outline is presented of the evaluation results of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data for forest areas in the Peninsula Malaysia. Four different areas were selected which represented different forest types, such as natural forest, secondary forest, swamp forest and mangrove forest. Some statistical analysis and the clustering analysis were performed on the MOS-1 MESSR

images of these forests. By the clustering analysis, six to 11 clusters appeared on each forest area. In each forest class, the ranges of data of both visible and infrared channels were very small (5 to 10 DN in visible and 9 to 21 DN in infrared). The vegetation index ((CH (Channel) 3+CH 4-CH 1-CH 2)/(CH 1+CH 2+CH 3+CH 4)) was found effective for delineating vegetation cover conditions in forest and agricultural land. Author (NASDA)

N92-26056# National Research Inst. for Earth Science and Disaster Prevention, Ibaraki (Japan). Atmospheric and Hydrospheric Science Div.

FLOOD MAPPING ON OCTOBER 17TH 1988 AROUND DHAKA IN BANGLADESH USING MOS-1 MESSR DATA

Kazurou Nakane *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 173-184 (For primary document see N92-26046 16-43)

Avail: NTIS HC/MF A19

Unprecedented flood runoff occurred in Brahmaputra River and the flood inundated a large area of 1.2 million sq km including the capital city of Dhaka. Fortunately, MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) caught the flooding condition on October 17, 1988, which was received at Bangkok in Thailand. The purpose of this study is application of MOS-1 MESSR data received at Bangkok for flood mapping in foreign countries. For this study, the detailed geographical map and MESSR image taken on October 17, 1988 are prepared, and MESSR image is corrected geometrically for superposing on the geographical map. Then, flooded areas in MESSR image are traced on the geographical map. This flooding map represents approximate ground levels on border lines of inundated areas and the distribution of lowlands and small higher lands in low-lying area. Through the study, it is understood that MOS-1 MESSR data received at Bangkok is useful for flood mapping, if MOS-1 MESSR data could catch flooded area.

Author (NASDA)

N92-26057# National Research Inst. for Earth Science and Disaster Prevention, Ibaraki (Japan).

VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR IN THE DELINEATION OF HEAVY RAINFALL DISASTER

Shinobu Yazaki and Shigetsugu Uehara *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 185-206 (For primary document see N92-26046 16-43)

Avail: NTIS HC/MF A19

To verify the effectiveness of MESSR (Multispectral Electronic Self-Scanning Radiometer) data in the field of disaster prevention, the data was applied to the delineation of areas damaged by the heavy rainfall which lasted from the end of June to the beginning of July 1990 in northern Kyushu island. The disaster shows various aspects of ground hazard; landslide, debris flow, inundation of mud flow or inner water inundation. The MESSR data, including the most severely damaged area taken in July shortly after the hazard was available to detect traces of the damages and other MESSR data of the same area taken nearly two years before the hazard, was utilized as a reference. The analysis was carried out in the following way. After registering geometrically and normalizing brightness level between the two images, the difference was calculated to find the change in brightness of each band. As a result, it was found that the change of land surface appears more clearly in bands 2 and 4 and the mode of the change was also found to be discriminable in the feature space of the two bands.

Author (NASDA)

N92-26058# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

RETRIEVAL OF UPPER PRECIPITABLE WATER PROFILE BASED ON MOS-1/VTIR H2O ABSORPTION CHANNEL DATA

Masao Matsumoto, Shigeyuki Takasaki, and Kiyoshi Tsuchiya *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 207-222 (For primary document see N92-26046 16-43)

Avail: NTIS HC/MF A19

An attempt is made to retrieve precipitable water profile within the range from top of the atmosphere down to the level of 500 mb based on MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) H2O absorption channel data. The precipitable water profile is retrieved by maximum likelihood solution of linearized radiative transfer equation which represents radiation conservation in the layered atmosphere. Up to 35 percent of root mean square error of the estimation occurred. The difference between observed Brightness Temperature (TB) and calculated TB through LOWTRAN 7 is about 10 K. Computed value is lower than the observed one, the cause of the difference is thought due to the estimation error. For more precise analysis, it is necessary to check overall function of VTIR together with absorption characteristics of radiation by H2O in the spectrum of VTIR H2O absorption channel. Author (NASDA)

N92-26059# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

SIMULTANEOUS ESTIMATION OF SEA SURFACE TEMPERATURE AND PRECIPITABLE WATER BASED ON MOS-1/VTIR DATA

Shigeyuki Takasaki, Masao Matsumoto, and Kiyoshi Tsuchiya *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 223-237 (For primary document see N92-26046 16-43)

Avail: NTIS HC/MF A19

In the retrieval of the precipitable water and the sea surface temperature simultaneously from the data of satellite observation based on the linearized radiative transfer equation, selection of the optimum initial guess values of sea surface temperature, air temperature and precipitable water play an important role. In this study, an attempt is made to select the optimum initial guess values for sub-areas around Japan based on a statistical method, taking into account the atmospheric conditions and the sea surface temperature. Based on these values, precipitable water and sea surface temperature are estimated from MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data and compared with sea surface temperature and precipitable water data. The results are in good agreement.

Author (NASDA)

N92-26060# Tohoku Regional Fisheries Research Lab., Miyagi (Japan). Fisheries Oceanography Div.

PROLOGUE OF APPLICATION OF MOS-1 VISIBLE DATA TO FISHING GROUNDS DETECTION: EXAMPLE ON SHIRASU, LARVAE OF SARDINE AND ANCHOVY

Denzo Inagake and Akira Tomosada *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 239-263 (For primary document see N92-26046 16-43)

Avail: NTIS HC/MF A19

Applicability of remote sensing data to fishing ground detection is discussed. The fishing grounds of Shirasu, that is the larvae of sardine and anchovy, are formed in the less saline coastal water and the frontal region between the offshore water and the less saline coastal water. Since the less saline water is the mixture of water from rivers and offshore water, and since Shirasu form schools in the surface layer, water color at the sea surface must contain some data on fishing grounds formation of Shirasu. High gain mode visible band image data of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) acquired on July 21, and August 25, 1989 were compared with the truth data of Shirasu fishing grounds to detect the oceanographic features of the fishing grounds. Several stripe-like structures (slicks) were detected parallel to the coast. Shirasu fishing grounds were distributed in the field of stripe-like structure detected by MOS-1 MESSR. The stripe-like structure was generated by internal wave which propagated inshore and reflected offshore at the coast. Author (NASDA)

N92-26061# Japan Fisheries Information Service Center, Tokyo.
STUDY OF MOS-1 VTIR DATA FOR VARIABILITY OF THE BRANCH (BE CALLED WARM STREAMER) FROM WARM EDDY AND FOR FISHING GROUND
Hideo Tameishi, Osamu Honda, Yoshihiro Okada, Toshiyuki Kouguchi, and Keiichi Iwata *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 265-292 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

The relationship between fine structure of warm eddy and fishing ground was investigated using the MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data with assistance of aircraft data. Interesting results obtained are as follow: (1) As MOS-1 VTIR imagery can represent the warm streamer, it is recognized that the spatial accuracy (2.7 km) is enough to appreciate the fine structure; (2) By using the simultaneous aircraft data, it is known that the many schools of sardine are distributed at the head of warm streamer; and (3) It seems that the warm streamer is useful for the transfer of schools toward the north. Author (NASDA)

N92-26062# National Inst. of Polar Research, Tokyo (Japan).
APPLICABILITY OF MOS-1 DATA RECEIVED AT SYOWA STATION TO THE ANALYSIS OF POLAR ATMOSPHERE AND CRYOSPHERE
Takashi Yamanouchi, Hiroshi Kanzawa, Makoto Wada, Fumihiko Nishio, and Sadao Kawaguchi *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 293-324 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Applicability of MOS-1 (Marine Observation Satellite-1) sensor data to the analysis of polar atmosphere and cryosphere is examined. Especially, analysis of MSR (Microwave Scanning Radiometer) data for the atmospheric water vapor and liquid water are explained in detail. From February 1989 to January 1990, data of 177 paths were received by the members of the 30th Japanese Antarctic Research Expedition (JARE) using newly settled multipurpose satellite data receiving system and recorded on HDDT (High Density Digital Tape). Most of those data are from paths between 54 to 70, which covers the region around Syowa Station. Applicabilities of the data to the research subjects are examined with the data of about 10 to 20 scenes of each sensor already processed. Using MSR data of 23.8 and 31.4 GHz, water vapor amount and liquid water content are estimated. For the normal condition, water vapor amount ranged from 0.4 to 1.4 g/sq cm and liquid water content from 0 to 14 mg/sq cm. However, there was a high liquid water content belt around 50 deg S in some paths, corresponding to high brightness temperature of about 190 K. On account of high brightness temperature of ice sheet or sea ice, it is difficult to obtain water vapor amount or liquid water content of atmosphere over those surfaces. Using the VTIR (Visible and Thermal Infrared Radiometer) data of clear area, methods to estimate the sea surface temperature are also examined.
Author (NASDA)

N92-26063# Nagaoka Technological Univ. (Japan).
OBSERVATION OF LINED-UP CUMULUS ROWS UNDER THE WINTER MONSOON SITUATION USING MOS-1 AND RADAR DATA
Tosio Koike, Hiroshi Ueda, and Yasushi Fujiyoshi (Nagoya Univ., Japan) *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 325-346 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Information on the three dimensional shape of clouds and the distributions of water vapor and cloud liquid water contents were derived from MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data. Cloud extent and cloud top temperature were determined using the visible band and two thermal infrared bands respectively. Water vapor and cloud liquid water contents over the sea were retrieved by two microwave bands of MSR and two thermal infrared bands of VTIR. Two scenes of MOS-1 were used. One is around western Hokkaido on December 28, 1988 and another is around Hokuriku on January 25, 1990. Snowfall distributions were observed using the ground based radars. There are usually two modes of cumulus rows under strong winter monsoon: transverse mode and longitudinal mode. Around western Hokkaido, the longitudinal perturbation was a preferred mode. The cloud top temperature rose over the land while cloud area was extended. The radar reflectivity was strong under the high cloud area. Around Hokuriku, snow clouds were the transverse mode. The cloud top temperature was dropped over the land by the orographic effect. The strong reflectivity area appeared the windward side of the cloud. The distributions of water vapor and cloud liquid contents can not be compared with radar reflectivity because of the strong land-radiation effect. This report is presented in viewgraph format. Author (NASDA)

N92-26064# Ministry of Agriculture, Forestry, and Fisheries, Ibaraki (Japan). Oceanic Fisheries Dept.
RESEARCH PROJECT FOR PRACTICAL USAGE OF MOS-1 DATA COLLECTION SYSTEM
Takeshi Ujiie and Akira Kuroiwa *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 347-366 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

For the purpose to improve marine productions, it is quite essential to study and to know the comprehensive oceanographic activities. In fiscal 1986 to 1988, the study and systems evaluation project of MOS-1 (Marine Observation Satellite-1) confirmed possibilities by placing DCP (Data Collection Platform) on board and measuring the water temperature at various depths of the seas. By using MOS-1 DCS (Data Collection System), real time data was collected, recorded, and analyzed for the possible application to fishing services. The project is further transacted to evaluate the performance and practical utilization of the hardwares used in the system from fiscal 1989 to 1991. In 1989, study was made not only on the sea water temperature but of the development of various sensors for the oceanographic observations and also for the improvement of compressed data transmission. For the project of fiscal 1990, on the foundation of the result of achievement in fiscal 1989, actual data transmission tests were carried out by using water temperature and salinity sensors. Further experiments are scheduled to improve the method of received data analysis and contrive to make DCP transmitter smaller and lighter.
Author (NASDA)

N92-26065# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.
MOS-1 DATA APPLICATIONS
Vincent Beruti *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 367-377 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Presented in viewgraph format, the status of EMDUP (European MOS-1 (Marine Observation Satellite-1) Data Utilization Program) is outlined. Topics addressed include: number of projects by the subjects and sensors; ratio of MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) scenes requested by country; sample of image data from MOS-1 MESSR sensor; and detection of algae in the Adriatic Sea.
Author (NASDA)

N92-26066# INTERA Technologies Ltd., Ottawa (Ontario).
SEA SURFACE TEMPERATURE COMPOSITE IMAGERY USING VTIR AND AVHRR
Daniel A. DeLisle and Marie-Catherine Mouchot (Canada Centre for Remote Sensing, Ottawa, Ontario) *In* NASDA, International

Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 379-397 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Features of oceans are in constant movement and frequent monitoring is crucial, thus real-time data is particularly valuable. Daily measurement is a requirement for factors such as the state and temperature of the sea since measurements quickly lose their value as time passes. One serious problem is cloud cover. Too often, not enough sea area is visible from one satellite observation. However, with the many thermal infrared sensors available now, it is possible to gather SST (Sea Surface Temperature) data from various sources for the same day, but not necessarily at the same time, and generate a composite image. The resulting mosaic could be quite cloud free when SST data are available from complementary data sources. If more than one temperature is found for the same area, the warmer temperature is recorded, assuming that cloud contamination is a cooling phenomenon. To demonstrate this application, SST from MOS-1 (Marine Observation Satellite-1) and NOAA were extracted for the same day and a composite image of the two was generated. Calibrated VTIR (Visible and Thermal Infrared Radiometer) data was obtained by MacDonald Dettwiler Associates (MDA) and raw AVHRR (Advanced Very High Resolution Radiometer) data from the Canadian Atmospheric Environment Service (AES). The study area is the Atlantic Coast of Canada, with MOS-1 covering the northern part of the area, and NOAA the southern portion. In between these areas, the coverage overlapped sufficiently to allow comparison. Although VTIR data has a coarser resolution than NOAA, the two were complementary and once calibrated, easily composited.

Author (NASDA)

N92-26067# Canada Centre for Remote Sensing, Ottawa (Ontario).
MOS-MESSR IMAGE GEOMETRIC CORRECTIONS
Thierry Toutin and Yves Carbonneau (Consultants TGIS, Inc., Montreal, Quebec) *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 399-413 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

The raw MOS (Marine Observation Satellite) MESSR (Multispectral Electronic Self-Scanning Radiometer) image has four bands which have a misregistration of three to four pixels. To avoid multiple resampling to obtain precise geocoded ortho image, a new methodology is described. It enables ortho image generation directly from each band of the raw image. The analysis of the pushbroom scanner and satellite motion geometries and the use of a photogrammetric approach enables the derivation of a vigorous mathematical model for geometric corrections and rectification of the raw MOS-MESSR images. The final accuracy of the geometric corrections is about 1/2 pixel (25 m). Six GCPs (Ground Control Points) are sufficient to achieve this accuracy. Enhancing the GCP acquisition will improve the final accuracy to a 1/3 pixel. A coarse DEM (Digital Elevation Model), with a 70 m accuracy, can be used for the generation of the ortho image, without degrading this accuracy. Author (NASDA)

N92-26068# National Research Council, Bangkok (Thailand). Remote Sensing Div.
MOS-1 DATA EVALUATION IN THAILAND
Chanchai Peanvijarnpong *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 415-425 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Presented in viewgraph format, MOS-1 (Marine Observation Satellite-1) data evaluation activities in Thailand are outlined. Topics addressed include: outline of MOS-1 data receiving system; ground station; MOS-1 coverage of Bangkok station; MOS-1 coverage in South-East Asia region; receiving condition at the ground stations of Thailand for MOS-1 data; and sample of imagery from MOS-1 data. Author (NASDA)

N92-26069# Land Development Dept., Bangkok (Thailand). Land Use Planning Div.
MOS-1 APPLICATION FOR LAND USE MONITORING AND CROPS YIELD ESTIMATION
Manu Omakupt *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 427-433 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Land Development Department, as an agency among the principle investigators has been participating in MOS-1 (Marine Observation Satellite-1) Verification Program. Research has been carried out by using MESSR (Multispectral Electronic Self-Scanning Radiometer) data of MOS-1 for land use monitoring and to estimate the paddy rice and sugar cane yields. The manual interpretation of MOS-1 images and the automated data analysis by using the MERIDIAN system were used in this study. The results were quite satisfying: high accuracy for land use monitoring and about 75.7 accuracy for rice and sugar cane yields estimation were achieved. MOS-1 data is also used, as much as the available data to map the present land use and the danger from disaster, such as major flooding and typhoon, in conjunction with LANDSAT-TM (Thematic Mapper) and SPOT data in Thailand will allow. However, even though Thailand has ground receiving stations for MOS-1 data reception, the real-time or very recent data are still unable to be gotten because the raw data of MOS-1 at the receiving station have to be sent back to process in Japan. This is one of the limitations that MOS-1 data cannot be promoted to use into an operational scale. Author (NASDA)

N92-26070# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Remote Sensing in Forestry.
APPLICATION OF MOS-1 DATA TO ASSESS DEFORESTATION IN THAILAND
Boonchana Klankamsorn *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 435-446 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Forest is an integral part of the ecosystem and its occurrence, structure and growth are intimately linked with the physical character of the landscape. Management of the forest is actually past and present land use practices. In order to locate and indicate what, where and how much of the forest resources need to be preserved and managed, remote sensing has been used as a tool for surveying and mapping to assess forest resources in Thailand. The satellite data not only LANDSAT, SPOT but also MOS-1 (Marine Observation Satellite-1) data from NASDA (National Space Development Agency of Japan) were used for this purpose. The visual interpretation and image analysis were conducted. MOS-1 data were verified for evaluation of deforestation in crisis area. The results revealed that MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) data can be used for detection of existing forest and non-existing forest areas in Thailand. Moreover, mangrove forest areas can be classified from other forest types. In some areas, if evergreen and dry dipterocarp forest types occur is widely spaced, they can be classified by using the help of bioclimatic and physiographic factors.

Author (NASDA)

N92-26071# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Soil Science Div.
THE APPLICATIONS OF MOS-1 DATA TO STUDY THE DAMAGES CAUSED BY TYPHOON IN RUBBER PLANTATION OF CHUMPHON PROVINCE, THAILAND
Pongpit Piyapongse, Ekanit Hansakdi, and Anop Kichtham *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation 31 Oct. 1990 p 447-457 (For primary document see N92-26046 16-43)
Avail: NTIS HC/MF A19

Natural disaster caused by typhoons results in severe damage in agricultural areas and causes more and more problems in Thailand. The use of satellite based data to study the damages is

a very useful tool for the government to send rescuers to these areas. MOS-1 (Marine Observation Satellite-1) from VTIR (Visible and Thermal Infrared Radiometer) sensors were used together with NOAA and SPOT data to study the movement and damage of typhoon 'Guy' which struck Chumphon province on November 4, 1989. The MOS-1 VTIR and MESSR (Multispectral Electronic Self-Scanning Radiometer) data were analyzed. Personal computers using MICRO-ASEAN software, NOAA-11 (infrared), SPOT and topographic maps of the study area were used in combination with ground information data collection. The results obtained are summarized to come to the following conclusions: (1) MOS-1 VTIR can be used effectively to study the formation of typhoon (tropical storm) and depressions together with other meteorological satellite data; (2) MOS-1 MESSR, when used during rainy season in tropical zones, can sense cloud covered problems; and (3) The result obtained indicated that about 130,000 rais of rubber plant, 138,202 rais of coconut, 89,126 rais of oil palm and 28,734 rais of rice plant in the study area were completely destroyed by the typhoon. In the future the combinations of data from various satellites will be a very useful tool to study the distribution and occurrence, processes and causes, the impacts, mitigation, and reduction of natural disasters on a global basis. Author (NASDA)

N92-25690# University Coll., London (England). Dept. of Electronic and Electrical Engineering.
TOPOGRAPHY FROM PULSE-LIMITED ALTIMETER ECHOES
Duncan Wingham *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 137-140 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25760# Helsinki Univ. of Technology, Espoo (Finland). Avaruustekniikan Lab.
ESA AND TKK (FINLAND) REMOTE SENSING PROGRAMS [EUROOPAN AVARUUSJAERJESTOEN JA TEKNILLISEN KORKEAKOULUN KAUKOKARTOITUSOHJELMAT]
Martti T. Hallikainen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 3-5 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25779# Oulu Univ. (Finland). Taehtitieteen Laitos.
REMOTE SENSING OF WATER REGIONS IN NORTHERN FINLAND [POHJOIS-SUOMEN VESIALUEIDEN KAUKOKARTOITUSTA]
Jouko Raitala *In its* Second Meeting of Finnish Space Researchers 1990 p 45-47 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-25225# Sandia National Labs., Albuquerque, NM.
X RAY OBSERVATIONS OF BOILING SODIUM IN A REFLUX-POOL-BOILER SOLAR RECEIVER
J. B. Moreno, G. C. Stoker, and K. R. Thompson Jan. 1992 82 p
(Contract DE-AC04-76DP-00789)
(DE92-009563; SAND-91-1538) Avail: NTIS HC/MF A05

X ray observations of boiling sodium in a 75-kW sub t reflux-pool-boiler solar receiver operating at up to 800 C were carried out. Both cinematographic and quantitative observations were made. From the cinematography, the pool free surface was observed before and during the start of boiling. During boiling, the free surface rose out of the field of view, and chaotic motion was observed. From the quantitative observations, void fraction in pencil-like probe volumes was inferred, using a linear array of detectors. Useful data were obtained from three of the eight probe volumes. Information from the other volumes was masked by scattered radiation. During boiling, time-averaged void fractions ranged from 0.6 to 0.8. During hot restarts, void fractions near unity occurred and persisted for up to 1/2 second. DOE

N92-25311*# Mechanical Technology, Inc., Latham, NY.
SPACE POWER DEMONSTRATOR ENGINE, PHASE 1 Final Report, Feb. 1984 - Sep. 1985
May 1987 234 p
(Contract NAS3-23883)
(NASA-CR-179555; NAS 1.26:179555; MTI-87TR36-Phase-1)
Avail: NTIS HC/MF A11

The design, analysis, and preliminary test results for a 25 kWe Free-Piston Stirling engine with integral linear alternators are described. The project is conducted by Mechanical Technology under the direction of LeRC as part of the SP-100 Nuclear Space Power Systems Program. The engine/alternator system is designed to demonstrate the following performance: (1) 25 kWe output at a specific weight less than 8 kg/kW; (2) 25 percent efficiency at a temperature ratio of 2.0; (3) low vibration (amplitude less than .003 in); (4) internal gas bearings (no wear, no external pump); and (5) heater temperature/cooler temperature from 630 to 315 K. The design approach to minimize vibration is a two-module engine (12.5 kWe per module) in a linearly-opposed configuration with a common expansion space. The low specific weight is obtained at high helium pressure (150 bar) and high frequency (105 Hz) and by using high magnetic strength (samarium cobalt) alternator magnets. Engine tests began in June 1985; 16 months following initiation of engine and test cell design. Hydrotest and consequent engine testing to date has been intentionally limited to half pressure, and electrical power output is within 15 to 20 percent of design predictions. Author

N92-25354# New Energy Development Organization, Tokyo (Japan).
ANALYSIS AND EVALUATION OF THE POSSIBILITY OF INTRODUCING PHOSPHORIC ACID FUEL CELLS
Mar. 1991 96 p
(DE92-783369; NEDO-P-9027) Avail: NTIS HC/MF A05

Each step in the manufacture of fuel cells is reviewed. The possibility of cost reduction in the process is investigated. Additionally, the feasibility of providing financial assistance for fuel cell buyers is investigated. Also, the present status and the future outlook of fuel cell development are discussed. In Japan, phosphoric acid fuel cells are beginning demonstration testing. A 200 kW test plant, for commercial and remote island use, has finished its demonstration test favorably. The test run of an 11 mW plant, for the production of electric power, is being conducted by a private company. The manufacture of each of the fuel cell's subsystems is semi-automated at this time. The costs are estimated to be reduced to 60 - 80 percent of the present costs in a 10 mW/year plant and TO 50 - 60 percent of the present costs in a 100 mW/year plant. DOE

N92-25465# Midwest Research Inst., Golden, CO.
THERMAL ENERGY STORAGE PROGRAM OVERVIEW: ADVANCED ENERGY CONCEPTS FOR UTILITIES
Feb. 1992 6 p
(Contract DE-AC02-83CH-10093)
(DE91-002188; DOE/CH-10093/111) Avail: NTIS HC/MF A02

This report discusses new technologies that provide an efficient means for capturing, storing, and reusing lost energy. America loses vast quantities of thermal energy each year in industrial, commercial, and domestic processes. Thermal energy storage provides a way to shift a portion of the electricity used for heating or cooling to off-peak periods. DOE

N92-25497# International Fuel Cells Corp., South Windsor, CT.
PHOSPHORIC ACID ELECTRIC UTILITY FUEL CELL TECHNOLOGY DEVELOPMENT
R. D. Breault, T. A. Briggs, J. V. Congdon, T. E. DeMarche, R. L. Gelting, G. J. Goller, W. L. Luoma, M. W. McCloskey, A. P. Mientek, and J. J. OBrien et al Apr. 1991 158 p
(Contract DE-AC21-83FE-60338)
(DE91-002096; DOE/FE-60338/3016; FCR-8305A) Avail: NTIS HC/MF A08

The major objective of this effort was the advancement of cell and stack technology required to meet performance and cost criteria for fabrication and operation of a prototype large area, full height phosphoric acid fuel cell stack. The performance goal for the cell stack corresponded to a power density of 150 wsf, and the manufactured cost goal was a 510 $/kW reduction (in 1981 dollars) compared to existing 3.7 ft.(exp 2) active area cell stacks. DOE

N92-25498# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
WIND ENERGY PROGRAM OVERVIEW
Feb. 1992 22 p
(Contract DE-AC02-83CH-10093)
(DE91-002178; DOE/CH-10093/101) Avail: NTIS HC/MF A03

This overview emphasizes the amount of electric power that could be provided by wind power rather than traditional fossil fuels. New wind power markets, advances in technology, technology transfer, and wind resources are some topics covered in this publication. DOE

N92-25506# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
MANUFACTURING OF ULTRA-HIGH EFFICIENCY THIN-FILM CONCENTRATOR CELLS
R. Gale (Kopin Corp., Taunton, MA.) Feb. 1992 27 p
(Contract DE-AC02-83CH-10093)
(DE92-001175; NREL/TP-214-4608) Avail: NTIS HC/MF A03

This report describes a research project to study developments required to expedite commercializing the GaAs solar cell concentrator technology. We baseline the GaAs concentrator cell and 1000X module design into pilot operation at Kopin Corporation. To attain these improvements, we will use Kopin's existing pilot line to produce cleavage of lateral epitaxial film for transfer (CLEFT) GaAs solar cells; these cells already exhibit efficiencies of about 24 percent at air mass 1.5. We will modify the CLEFT cell to form concentrators that perform well at 500-1000 suns. We will derive the know-how for this modification from an integration of Kopin and VS Corporation technologies. The pilot line will be broadened to include cell receiver and module assembly, using VS Corporation technology obtained from Varian as a baseline. A second-generation design will be formulated to address improvements in the module, and these will be incorporated into the pilot line along with the CLEFT concentrator cell. In parallel, we integrate Kopin's CLEFT GaAs cell technology with the advanced AlGaAs and InGaAs material technology obtained by VS Corporation from Varian to develop a near-term, two-junction mechanical stack with an efficiency of 35 percent. The receiver thus developed will be compatible with a three-junction approach that has been proposed elsewhere by Kopin. Using a three-junction stack can yield an efficiency of over 40 percent, and when such cells become available, the pilot line process will have been designed to use them. DOE

N92-25647# University Coll. of Wales, Aberystwyth. Dept. of Physics.
SOLAR-TERRESTRIAL ENERGY PROGRAM: PROCEEDINGS OF THE 5TH WORKSHOP ON TECHNICAL AND SCIENTIFIC ASPECTS OF MST RADAR
1991 539 p Workshop held in Aberystwyth, Wales, 6-9 Aug. 1991 Sponsored by Japanese STEP fund of Grant-in-Aid for Scientific Research of Ministry of Education
Avail: NTIS HC/MF A23

The proceedings are divided into ten subject areas. The subjects of radar returns from clear air, gravity waves and turbulence, and technical aspects of the design of the MST radar continue to be topics of major interest. Conventional Doppler and spaced antenna methods of wind measurement occupied the majority of papers but the use of spatial domain and frequency domain interferometer techniques also featured strongly. The ten subject areas are as follows: meteorological applications; interpretation of radar returns from clear air; structure and dynamics of lower and middle atmosphere at equatorial and polar latitudes; techniques for studies of gravity waves and turbulence; coordinated studies using MST/ST radars and other ground based techniques; interferometer, spaced antenna and RASS techniques; hardware design for MST/ST radars and lower troposphere profilers; signal processing and data analyses; progress on existing or planned MST and ST radars; and miscellaneous discussions. Author

N92-25987# Portland State Univ., OR. Dept. of Chemistry.
IMPROVED ELECTROLYTES FOR FUEL CELLS
G. L. Gard and D. K. Roe Jun. 1991 60 p
(Contract DE-FG21-88MC-25142)
(DE91-002093; DOE/MC-25142/3013) Avail: NTIS HC/MF A04

Present day fuel cells based upon hydrogen and oxygen have limited performance due to the use of phosphoric acid as an electrolyte. Improved performance is desirable in electrolyte conductivity, electrolyte management, oxygen solubility, and the kinetics of the reduction of oxygen. Attention has turned to fluorosulfonic acids as additives or substitute electrolytes to improve fuel cell performance. The purpose of this project is to synthesize and electrochemically evaluate new fluorosulfonic acids as superior alternatives to phosphoric acid in fuel cells. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-25170# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
THERMOHALINE CIRCULATIONS AND GLOBAL CLIMATE CHANGE
H. P. Hanson 1992 4 p
(Contract DE-FG02-90ER-61019)
(DE92-008796; DOE/ER-61019/2) Avail: NTIS HC/MF A01

'Thermohaline Circulations and Global Climate Change' is concerned with investigating the hypothesis that changes in surface thermal and hydrological forcing of the North Atlantic, changes that might be expected to accompany CO2 induced global warming, could result in ocean-atmosphere interactions' exerting a positive feedback on the climate system. Because the North Atlantic is the source of much of the global ocean's reservoir of deep water, and because this deep water could sequester large amounts of anthropogenically produced CO2, changes in the rate of deep-water production are important to future climates. Since deep-water production is controlled, in part, by the annual cycle of the atmospheric forcing of the North Atlantic, and since this forcing depends strongly on both hydrological and thermal processes as well as the windstress, there is the potential for feedback between the relatively short-term response of the atmosphere to changing radiative forcing and the longer-term processes in the oceans. DOE

N92-25226# European Space Agency, Paris (France).
EURISY SYMPOSIUM ON THE EARTH'S ENVIRONMENT: AN ASSESSMENT FROM SPACE
T. D. Guyenne, ed. Oct. 1991 136 p In ENGLISH and FRENCH Symposium held in Venice, Italy, 10-11 Apr. 1991; sponsored by ESA, CEC, ASI, BNSC, CNES, DARA, CICYT/INTA
(ESA-SP-337; ISBN-92-9092-190-0; ETN-92-91275) Copyright Avail: NTIS HC/MF A07

The use of space technology to better monitor and assess the state of the Earth's environment is discussed. Natural factors and human effects on climate are considered. The consequences of

ozone layer evolution are discussed. The use of remote sensing in monitoring the environment is described. Models of global climate change are presented. The policies of various European governments in developing environmental space programs are described. Space technologies used in atmospheric and environmental monitoring are summarized. Threats of desertification and their appraisal are discussed. For individual titles, see N92-25227 through N92-25247.

N92-25227# Copenhagen Univ. (Denmark). Inst. of Geography.
IS THERE A THREAT?
Aksel Wiin-Nielsen *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 17-18 (For primary document see N92-25226 16-45)
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A brief analysis of other various threats to environmental systems is presented. Requirements for observations and monitoring are reviewed. The nature of models of natural systems are discussed with the climate system as an example. The need to develop climate models such that they be more realistic both in the description of the internal processes in the atmosphere and in incorporating all other components of the climate systems is stressed. ESA

N92-25228# Universite Catholique de Louvain (Belgium). Inst. d'Astronomie et de Geophysique G. Lemaitre.
NATURAL FACTORS AND/OR HUMAN EFFECTS ON CLIMATE
Andre Berger *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 19-29 (For primary document see N92-25226 16-45)
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Interactions between man's activity, greenhouse effects and cyclical climatic fluctuations on the Earth are discussed. Simulation of climatic systems over a geological time scale is discussed. The time scale of such research is beyond most climatic models developed to date. Validation and sensitivity analysis of such climatic models is stressed as being crucial to better understand man's impact on climate. It is concluded that the greenhouse warming of the next century is unavoidable, possibly rivaling the temperature change between the last glacial maximum 20,000 years ago and today. ESA

N92-25229# Danish Hydraulic Inst., Horsholm.
COASTAL POLLUTION
Jacob Steen Moeller *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 31-35 (For primary document see N92-25226 16-45)
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The coastal zone is a limited resource. As population grows, the strain on the coastal zone is rapidly increasing. The following types of coastal pollution are described: organic waste, chemical waste, oil spills, solid waste, dredging spoil, siltation and nutrients. The growing exploitation of the coastal zone contributes to the deterioration through overfishing, reduced fresh water quality, visual pollution and loss of wetlands. A few examples from the Mediterranean, the Black Sea and the North Sea are highlighted. National and international action needed to abate the threat to the coastal zone is called for. Limited success is gained in reducing chemical pollution in some cases, while the threats associated with agriculture and fishing are growing. ESA

N92-25230# Cambridge Univ. (England). Dept. of Chemistry.
THE OZONE LAYER EVOLUTION: ITS CONSEQUENCES
John A. Pyle *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 37-38 (For primary document see N92-25226 16-45)
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The production rate of ozone in the upper atmosphere is discussed. The Ozone loss through a variety of catalytic cycles, with the active catalysts being oxides of nitrogen, chlorine and hydrogen present in low concentrations, is discussed. The loss rate is proportional to the concentration of these compounds. The ozone hole is concluded to be due to chemical processes involving chlorine derived from man-made compounds. Evidence that cloud particles in the polar lower stratosphere play an important role in elevating the levels of radioactive chlorine is discussed. ESA

N92-25231# Meteorology Bureau, Boulogne (France). Etablissement d'Etudes et de Recherches Meteorologiques.
THE THREAT OF DESERTIFICATION: SCIENTIFIC APPRAISAL AND SOME PROPOSALS FOR ACTION
Jean-Claude Andre *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 39 (For primary document see N92-25226 16-45)
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The problem of climatic desertification and desertification threatened areas is discussed. The reason for this threat, the areas in danger, and what should be done is considered. Uncertainty about possible modifications of the hydrological cycle in response to increased greenhouse warming is discussed. It is known, for example, if precipitation will either decrease, or if precipitation distribution throughout the year will change. It is however clear that the temperature increase will be significant enough to affect water availability, through increased evaporation and evapotranspiration early in the season. It is likely that there will be a noticeable decrease in water availability in the upper soil layers. Pooling scientific resources from interested countries, to increase monitoring efforts, conduct special observational in situ programs and develop improved modeling and forecasting capacities is called for. ESA

N92-25232# Telespazio, S.p.A., Rome (Italy).
REMOTE SENSING AND THE ENVIRONMENT
Raffaele Minicucci *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 41-42 (For primary document see N92-25226 16-45)
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Monitoring of the environment is a main issue where all available technology should be used in a very synergic and efficient way. Space remote sensing, a valuable tool for Earth observation and evaluation of several environmental processes such as climatological changes, sea water pollution, desertification, and other such processes is described. An overview of remote sensing application related to these topics is presented. Various Italian initiatives in setting up a Mediterranean Remote Sensing Center (MRSC) as well as an agrometeorology and environmental information network are described. The issue of training remote sensing network users is addressed. ESA

N92-25233# Imperial Coll. of Science and Technology, London (England). Center for Environmental Technology.
MODELS OF GLOBAL CLIMATE CHANGE
John Mason *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 47-56 (For primary document see N92-25226 16-45)
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Increases in carbon dioxide and the other greenhouse gases are together likely to approximate to a doubling of the present concentrations of CO2 by the year 2050. Current best estimates based on large, complex coupled atmosphere-ocean models, indicate that this would produce an average global surface temperature rise of 2.5 degrees centigrade and a sea level rise of 540 cm. However, the model predictions are sensitive to the treatment of clouds and their influence in radiation, so that improved understanding of these and other feedback mechanisms is necessary to reduce uncertainties in current predictions and provide firmer scientific guidance for remedial action. ESA

N92-25234# World Climate Programme, Geneva (Switzerland).
SPACE OBSERVATION REQUIREMENTS FOR GLOBAL CLIMATE SCIENCE AND PREDICTION
Paul Morel *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 57-59 (For primary document see N92-25226 16-45)
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Predicting global climate change requires understanding the mechanisms of transient climate variations to an unprecedented level of accuracy. Climatological research is basically dependent upon the information inferred from global weather analyses so that the requirements of climate science are, firstly, for improved temperature, moisture and wind measurements from space. Global measurements of radiation fluxes at the top of the atmosphere, cloud extent and properties, and rainfall are called for. Global measurements of sea surface temperature, wind and geopotential altitude or topography, ocean color and extent of sea ice are also of importance. The time dependence properties of the land surface vegetation and soil moisture are important data to be expected from the future space based Earth Observing System (EOS).
ESA

N92-25235# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
OPERATIONAL OBSERVATION OF THE EARTH FROM SPACE METEOROLOGY, CLIMATOLOGY, EARTH RESOURCES, ENVIRONMENT
John Morgan *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 61-65
(For primary document see N92-25226 16-45)
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The classes of operational Earth observation satellites and some examples of their principle uses are discussed. Emphasis is given to the operational meteorological satellites, which have already provided data for more than thirty years. Commercial remote sensing satellites are also discussed. Geostationary meteorological satellites and typical missions of such satellites are described. Polar orbiting meteorological satellites and their typical missions are outlined. Different commercially oriented Earth resource satellites are described. The role of these different types of satellites on developing a picture of global change is discussed.
ESA

N92-25236# Rutherford High Energy Lab., Chilton (England). Space Science Dept.
SPACE DATA FROM SCIENTIFIC PROJECTS
J. E. Harries *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 67-76
(For primary document see N92-25226 16-45)
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A brief review of the use of Earth observation from space for scientific studies of the global environment is presented. Examples are given of observations of the atmosphere, oceans, and other components of the climate system, which illustrate the power of global data sets which are uniquely available from space. Some lessons for future research are discussed. ESA

N92-25237# European Space Agency, Paris (France).
THE EUROPEAN SPACE AGENCY'S CONTRIBUTION TO EARTH OBSERVATION FROM SPACE
Jean-Marie Luton *In its* EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 77-81
(For primary document see N92-25226 16-45)
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The major Earth observation activities carried out by ESA are outlined. The role of space technology in providing a better understanding of the forces that shape the Earth's environment is stressed. The Meteosat program is summarized. The ERS satellite missions are discussed. The polar orbit Earth observation mission is described. The contributions these various missions have made to better understanding environmental factors are outlined. The Applications and Research Involving Space Techniques for the Observation of The Earth's fields from Low Earth orbit Spacecraft (Aristoteles) mission is discussed. ESA

N92-25238# Aerospatiale, Les Mureaux (France).
EUROPEAN INDUSTRIAL CAPABILITIES TO PROVIDE METEOROLOGICAL SPACE SYSTEMS
Michel Delaye *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 83-87
(For primary document see N92-25226 16-45)
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Avoidance of technological gambles and determination to arrive simple specific actions are identified as being key aspects of Meteosat's success. As the first European operational space program, Meteosat has proven how a well conceived system, developed and maintained in a close knit collaboration between space agencies and European industries, can stay alive from the early seventies to the year 2000. European industrial companies extend their action in the framework of the ESA-Eumetsat collaboration on second generation Meteosat as well as in the framework of the Eumetsat-NOAA potential collaboration for meteorological polar satellites. European industrial capabilities in design and development of spaceborne sensors for advanced meteorological and environmental instruments, are described. Meteosat speaks for the ability of European industry to contribute to the development and operation of a spaceborne operational system for the observation and study of the Earth's environment.
ESA

N92-25239# MATRA Espace, Paris-Velizy (France).
MATRA MARCONI SPACE AND THE EARTH'S ENVIRONMENT MONITORING SYSTEMS
Claude Gourny *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 89-91
(For primary document see N92-25226 16-45)
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The involvement of Matra Marconi Space in Earth observation from space is summarized. Involvement of the company on the SPOT, Helios, Meteosat and ERS programs is discussed. Atmos and Globsat mission concepts are outlined. The instruments aboard Globsat are described as is the total payload mass. A diagram of the general configuration of Globsat is presented. A general architecture for the Atmos, Globsat, ERS, SPOT network is shown in diagrammatic form. Ways to achieve cost savings and improvement in quality are suggested. ESA

N92-25240# Fiat Spazio, Rome (Italy).
THE CASE OF A SMALL LAUNCHER FOR ENVIRONMENTAL MISSIONS REQUIRING THE USE OF SMALL PAYLOADS c15
Giuseppe Grande *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 93-95
(For primary document see N92-25226 16-45)
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Launcher needs for environmental space missions are discussed. The use of small satellites put into low orbits using small expendable launchers in environmental space missions is considered. These small satellites are considered to be between 200 and 1000 kg in mass and their cost is typically expected to be around ten million dollars. Various Scout launchers designed to launch satellite in equatorial orbits for payload masses of 200 kg to 800 kg are presented. These same launchers are designed to place satellites from 150 kg to 600 kg in polar orbit. ESA

N92-25241# Alenia Spazio S.p.A., Turin (Italy).
ECOSAT: AN ITALIAN CONTRIBUTION TO GLOBAL EARTH ENVIRONMENT CONTROL
Ernesto Vallerani *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 97-105
(For primary document see N92-25226 16-45)
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Ecosat, a program to be devoted to the study and monitoring of the environment and to the measurement and understanding of the effects of human activity on the environment, is described. Its principal aim will be to monitor the Mediterranean Basin, northern Europe and the equatorial zone. The possibility exists of extending the service to other areas of the globe. A preliminary mission being defined in response to the requirements derived by the Italian Space Agency from the needs of different users, such as the ministry of Civil Protection, and the Ministry for the Environment, the Ministry of Agriculture and Forestry, and other orgnizations is described. ESA

N92-25242# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
THE ENGAGEMENT OF GERMAN SPACE INDUSTRY IN NATIONAL AND EUROPEAN ENVIRONMENTAL SPACE PROGRAMMES Abstract Only
Eckart Langelueddecke *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 107 (For primary document see N92-25226 16-45)
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The broad awareness of environmental problems has clearly grown during the last decade in connection with the knowledge that solutions will rarely be available on a national basis but will require large scale or even global considerations. It has also become obvious in the past that effective countermeasures tend to have severe economical impacts. Comprehensive and accurate information in environmental phenomena, processes, and interactions are needed to move the responsible authorities into action. Some of those requirements and the contributions which can be provided by Earth observation satellites are summarized. Typical Earth observation missions with major involvement of the German space industry, like ERS-1, Atmos, and POEM-1, are described together with their mission objectives and relations to environmental questions. An overview is given of active and passive sensors and instruments, operating in different spectral areas and frequency bands. Examples of German space industry's activities in the fields of ground segment development and data processing and utilization are presented. ESA

N92-25243# Consejo Superior de Investigaciones Cientificas, La Laguna (Spain). Inst. de Astrofisica de Canarias.
PLANETARY VISION AS A STRATEGY
Francisco Sanchez *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 113-115 (For primary document see N92-25226 16-45)
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From space the Earth can be seen from the outside. This must be taken into consideration when making models with planetary vision of the layer which we call the Earth's environment. The fundamental problems are global; therefore tackling them, and getting to the root of the matter, requires not an analytical but rather a synthetic approach, with planetary vision. The history of human progress can be understood as a cultural and financial conquest by a series of scales; we are only now entering into the planetary scale. This is another reason why the role which Space can play is decisive. It can provide mankind with a radically different way of contemplating his habitat. It can show him his home from the outside. This makes it even more obvious that we all depend on everyone and everything. Research programs carried out throughout Spain in the areas of teledetection and multidisciplinary modeling of topics related to environmental research are described. ESA

N92-25244# Cabinet Office, London (England).
THE UK SPACE POLICY
William D. P. Stewart *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 117-119 (For primary document see N92-25226 16-45)
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The policy of the UK (United Kingdom) government in various aspects of space research are summarized. Government funding of Earth observation from space in the ERS 1 and ERS 2 platforms is discussed. British commitment to ESA is summarized. The role of the British National Space Center (BNSC) is outlined. The role of the Natural Environmental Research Council (NERC) is described. Need for interaction between space research, and physical and biological sciences in gaining a better understanding of the environment is stressed. ESA

N92-25245# State Secretary of Science Policy, Brussels (Belgium).
THE ROLE OF BELGIUM IN EARTH OBSERVATION FROM SPACE PROGRAMS [LA BELGIQUE ET LES PROGRAMMES D'OBSERVATION DE LA TERRE A PARTIR DE L'ESPACE]
Eric Derycke *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 121-123 In FRENCH (For primary document see N92-25226 16-45)
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The role played by Belgium in Earth observation from space programs is outlined. The role of Belgium in the SPOT program, the Mir Infra Red Atmosphere Spectrometer (MIRAS), the space teledetection program and the global change program is described. The need for including considerations of life quality, starting with a concern for the environment in the politics of scientific research is stressed. The consequences of such an approach to scientific research in general and space research in particular are considered. ESA

N92-25246# National Committee for Technological Development, Budapest (Hungary).
POLICY FOR HARMONISING AND OPTIMISING FACILITIES IN THE HUNGARIAN R AND D SECTOR c81
Erno Pungor *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 125-127 (For primary document see N92-25226 16-45)
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The difficulties faced by Hungary in developing research and development (R & D) capabilities are outlined. The research policies of Hungary in the past are summarized. The success of cooperative ventures with other countries in research and development projects is discussed. The problem of a brain drain out of Hungary is addressed. Various statistics regarding the percent of the gross national product devoted to research and development in Hungary and the amount of money available for researcher salaries are presented. ESA

N92-25247# Commission of the European Communities, Brussels (Belgium).
PANEL DISCUSSION ON ASSESSMENT OF THE EFFECTIVENESS OF CURRENT POLICIES, ACTIONS AND ORGANISATIONS
Jean-Pierre Contzen *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 129-130 (For primary document see N92-25226 16-45)
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The position taken by the European Community at the second world climate conference is described. The unprecedented rate of climate change predicted by the Intergovernmental Panel on Climate Change (IPCC) indicates that action must be taken immediately. The economic impact of measure to be taken is considered to be less apocalyptic than many predictions. The need for increased further research to monitor the effectiveness and impact of adaptive actions and to provide a basis for policy adjustment is stressed. Three immediate main areas of action are identified. These are a ban or limitation in chlorofluorocarbons (CFS's), protection of the tropical forest and stabilization of CO2 emissions. ESA

N92-25269# Lawrence Livermore National Lab., CA.
COMPARISON OF CLIMATE DATASETS USING SPATIAL HISTOGRAMS
S. L. Grotch Nov. 1991 6 p Presented at the 16th Annual Climate Diagnostic Workshop, Lake Arrowhead, CA, 28 Oct. - 1 Nov. 1991
(Contract W-7405-eng-48)
(DE92-007328; UCRL-JC-108941; CONF-9110279-3) Avail: NTIS HC/MF A02

One of the most commonly used procedures in statistical analysis is the display of a distribution using a histogram. Although frequently used in many aspects of meteorology, surprisingly the technique has received relatively little recent attention as a climate diagnostic, particularly for intercomparisons. As will be seen, histograms can provide valuable information for both data verification and for statistical intercomparison. DOE

N92-25313# Department of Energy, Washington, DC. Office of Environmental Analysis.
LIMITING NET GREENHOUSE GAS EMISSIONS IN THE UNITED STATES
R. A. Bradley, ed., E. C. Watts, ed., and E. R. Williams, ed. Sep. 1991 529 p
(DE92-007267; DOE/PE-0101) Avil: NTIS HC/MF A23

Over the past decade, global climate change has been a subject of growing concern. The United States government in general, and the US Department of Energy in particular, have increased their level of activity in this area in recent years; since the 1970's, the DOE has sponsored scientific research programs in global climate change. These programs have sought to define the issues, reduce uncertainties, and quantify the interaction of global human and natural systems. Understanding the relationship between the production and use of energy and the accumulation of radiatively active gases in the atmosphere, as well as the consequences of this relationship for global climate systems, has been of particular interest, because constructive policy cannot be formulated without a firm scientific grasp of these issues. The National Energy Strategy was developed to address all of the nation's energy concerns, taking into account related environmental issues such as global climate change. Actions included in the National Energy Strategy are projected to hold US energy-related emissions of greenhouse important gases, weighted by IPCC-estimated global warming potential (GWP) coefficients, at or below 1990 levels through the year 2030. DOE

N92-25328# Westinghouse Savannah River Co., Aiken, SC.
ESTIMATING DEPOSITION VELOCITY FROM ATMOSPHERIC RELEASES OF IODINE
C. E. Murphy, Jr. Feb. 1991 8 p
(Contract DE-AC09-89SR-18035)
(DE92-009449; WSRC-TR-91-72) Avail: NTIS HC/MF A02

Deposition velocity is a parameter used in atmospheric transport models to specify the amount an atmospheric constituent transferred from the atmosphere to the surface of the earth. The material may deposit on the surface of soil, water, or vegetation. The deposition may be the result of rainfall or diffusion. A method for the calculation of deposition velocity based upon the decrease in deposition with distance from a point source is presented. The method does not require a knowledge of the time over which the deposition occurs or the concentration of the material in the atmosphere. However, the method does assume the deposition rate is proportional to the air concentration. The sensitivity to errors resulting from certain errors in the measurements and from violation of some of the assumptions of the model underlining the calculations are also to be discussed. The method has been used to estimate the deposition velocity of I-129. Two sets of I-129 deposition data at various distances from the center of SRS were used in the calculations. The results indicate that the deposition velocity is near a value of 0.2 cm/s. This is consistent with the processes that are known to control iodine deposition. DOE

N92-25330# California Univ., Berkeley. Lawrence Berkeley Lab.
CO2 EMISSIONS FROM DEVELOPING COUNTRIES: BETTER UNDERSTANDING THE ROLE OF ENERGY IN THE LONG TERM
J. Sathaye, ed. and N. Goldman, ed. Jul. 1991 82 p
(Contract DE-AC03-76SF-00098)
(DE92-009504; LBL-30060) Avail: NTIS HC/MF A05

Recent years have witnessed a growing recognition of the link between emissions of CO2 and changes in the global climate. Of all anthropogenic activities, energy production, and use generate the single largest portion of these greenhouse gases. Although developing countries currently account for a small share of global carbon emissions, their contribution is increasing rapidly. Due to the rapid expansion of energy demand in these nations, the developing world's share in global modern energy use rose from 16 to 27 percent between 1970 and 1990. If the growth rates observed over the past 20 years persist, energy demand in developing nations will surpass that in the countries of the Organization for Economic Cooperation and Development (OECD) early in the 21st century. The study seeks to examine the forces that galvanize the growth of energy use and carbon emissions, to assess the likely future levels of energy and CO2 n selected developing nations and to identify opportunities for restraining this growth. The purpose of this report is to provide the quantitative information needed to develop effective policy options, not to identify the options themselves. These individual studies were conducted for China, India, Indonesia, and South Korea. DOE

N92-25415# General Accounting Office, Washington, DC.
GLOBAL WARMING. EMISSION REDUCTIONS POSSIBLE AS SCIENTIFIC UNCERTAINTIES ARE RESOLVED
Sep. 1990 74 p
(GAO/RCED-90-58; B-240222) Avail: NTIS HC/MF A04; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

It was concluded that industrial and agricultural activities are causing the atmospheric concentrations of greenhouse gases to exceed historic levels. Without action now, these concentrations are likely to grow, although the rate of increase is uncertain. From their review of computer modeling results, most climate scientists agree that the climate's response to this growth will be an increased average temperature over the next 100 years. They do not concur, however, on the timing and magnitude of this change or on the associated regional climate changes. While research should reduce these scientific uncertainties, quick fixes or easy answers are unlikely to emerge. Rather, research results are expected to continue pointing to the need for a comprehensive, multinational, multidecade response strategy. In the meantime, many agree that certain actions can be justified because they have benefits in addition to reducing greenhouse gases. Reducing CFC's is an example of one such activity already under way, and more can be done in other areas, such as improving energy efficiency.
Author

N92-25499# Ames Lab., IA.
DEVELOPMENT OF ENGINEERING PARAMETERS FOR THE DESIGN OF METAL BIOSORPTION WASTE TREATMENT SYSTEMS Ph.D. Thesis
W. S. Graham 3 Dec. 1991 89 p
(Contract W-7405-eng-82)
(DE92-004850; IS-T-1550) Avail: NTIS HC/MF A05

Untreated landfill leachates and wastes from metal plating and mining operations are sources of environmental contamination by heavy metals. Because of their toxicity and potential for accumulation, the discharge of heavy metals must be controlled. Standard physical and chemical treatments used to remove metals from wastes such as concentration by electro-precipitation, ion exchange, solvent extraction, evaporative recovery, and conventional precipitation, are usually expensive and produce high quantities of sludge. Biosorption is the removal of metals from aqueous solutions by microorganisms. It is called biosorption rather than bioadsorption or bioaccumulation because the mechanisms of removal are not restricted to adsorption or metabolic uptake and so the more general term is preferable and has come to be accepted. In this thesis the focus is one two microorganisms and two metals. However, the possible combinations of conditions such as pH, relative metal molarities, time of contact, and organism are numerous. These experiments are designed to provide optimized parameters to facilitate the design of a functioning biosorption system. The two metals chosen for study are copper and lead in aqueous solution. The two types of microorganisms chosen for testing include an actinomycete and a fungus. The purpose of this research is to identify the significant engineering parameters to be evaluated include reaction rates, equilibrium partitioning of metal ions between those in solution and those removed to the cells, optimum pH for achieving the removal or recovery goal, and biosorption selectivity for one metal over another. DOE

N92-25507# Department of Energy, New York, NY.
ENVIRONMENTAL MEASUREMENTS LABORATORY ANNUAL REPORT 1989
N. A. Chieco, ed. and J. Hoppen, ed. Mar. 1991 169 p
(DE92-004857; EML-537) Avail: NTIS HC/MF A08

This report presents brief summaries of research from the Environmental Measurements Laboratory in the following areas: Radiation Physics; Applied Mathematics; Environmental Studies; and Analytical Chemistry. DOE

N92-25522# Pechan (E. H.) and Associates, Inc., Durham, NC.
NATIONAL AIR POLLUTANT EMISSION ESTIMATES 1940 - 1990
Nov. 1991 99 p Sponsored in part by EPA
(PB92-152859; EPA/450/4-91/026) Avail: NTIS HC/MF A05

The U.S. Environmental Protection Agency's latest estimates of national and regional emissions for criteria air pollutants and total particulate matter, including fine particulate matter (PM-10), sulfur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (VOC), carbon monoxide (CO), and lead are presented. Given here is new information on the regional trends of all criteria pollutant emissions including, for the first time, fugitive dust PM-10 emissions. Also presented are emissions for the nation to the years 2000 and 2010, and comparison of ozone season and annual daily average emission of VOC and NOx. Author

N92-25530 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
ENVIRONMENTAL RADIOACTIVITY INTERCOMPARISON WORKSHOP
F. E. Clark Sep. 1991 35 p Workshop held in Teddington, England, 17-18 Jan. 1991
(NPL-RSA(EXT)-22; ISSN-0955-9655; ETN-92-91046) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

Papers given at a workshop following a national intercomparison exercise are presented. The aim was to examine problems encountered while measuring the samples. Laboratories involved in the exercise were invited to discuss the results of pure beta emitter and beta/gamma emitter samples. They were also encouraged to put forward ideas for future needs for environmental radioactivity standards and for future intercomparison exercises. For individual titles, see N92-25531 through N92-25536.

N92-25531 National Physical Lab., Teddington (England).
BETA INTERCOMPARISON EXERCISE
S. M. Jerome *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 3-4 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

Analysis of samples containing pure beta emitters strontium 90, tritium and sulphur 35 by 23 laboratories is considered. These nuclides were chosen because of their importance in environmental monitoring of radioactivity. The results from participating laboratories using the 'u' test are presented and discussed. It is concluded that the results were reasonable but could have been better. It is suggested that more attention needs to be paid to factors contributing to uncertainties. ESA

N92-25532 National Physical Lab., Teddington (England).
ASPECTS OF LIQUID SCINTILLATION COUNTING **c72**
J. C. J. Dean *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 5-6 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

Two aspects of liquid scintillation counting are presented, evaluated and discussed. The first covers scintillation processes, quenching and quench correction techniques and the second covers sample preparation techniques. It is stated that emulsion counting is the most popular heterogeneous sample preparation technique but that users must be aware of its limitations. Its efficiency is affected by the amount and type of aqueous solution added to the sample, due to photon quenching, by count rate stability and emulsion stability. Also, counting results are affected by the phase location of the isotope by the sample concentration and the temperature of the surroundings. These points demonstrate the importance of using a standard which should mimic the samples under study in all possible respects. The preferred method of quench correction is by Internal Standardization (IS) or by the Sample Channels Ratio (SCR) method. The External Standard Channels Ratio (ESCR) method is inapproriate unless photon quenching is absent. The counting efficiency must be the same throughout the sample, irrespective of the phase location of the activity and this may be quantitatively assessed by the SCR method in conjunction with the ESCR method. When counting suspended solids in gels, account must be taken of the particle sizes and the particle size distribution. ESA

N92-25533 National Physical Lab., Teddington (England).
GAMMA INTERCOMPARISON EXERCISE **c72**
S. M. Jerome *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 7-9 (For primary document see N92-25530 16-45)
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Analysis of a sample by fifty participants is considered. The five nuclides in the sample were Ba-133, Ce-144, Co-60, Cs-134, and Zn-65. The cascade summing produced by Ba-133 and Cs-134 was of particular interest. Cs-134 and Ce-144 were chosen because they are major fission products. Co-60 and Zn-65 were used because they are major activation products. The analysts data were compared by a u test; 85 percent of the results were acceptable having less than 2.58. The results that are rejected were mainly those of Ba-133 and Cs-134. Cascade summing is exhibited by both these nuclides. The results are given and discussed. It is concluded that they were good but that there is still room for improvement. The major problems were still due to cascade summing and inadequate nuclear data. ESA

N92-25534 Central Veterinary Lab., Weybridge (England).
GOVERNMENTAL RADIOACTIVITY MONITORING PROGRAMMES Abstract Only
A. E. Lally *In* National Physical Laboratory, Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 10 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

An outline of the talk in government radioactivity monitoring is given. The monitoring programs for radioactivity that are organized by governmental departments are based on their areas of responsibility. The departments and their areas of responsibility are given. The following were discussed: the range of materials collected and the analyses carried out; the considerations involved in the choice of an analytical method and an outline of the steps in a typical method; the importance of quality and the quality control of data from such a program; the monitoring of such programs. ESA

N92-25535 London Scientific Services (England).
NON-GOVERNMENTAL RADIOACTIVITY MONITORING Abstract Only
M. Pullen *In* National Physical Laboratory, Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 11-13 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

An outline of a talk given on nongovernmental radioactivity monitoring is given. This monitoring is needed by local authorities and is carried out by local authorities themselves or others including environmental health officers. The objectives of the local authorities concerning this monitoring are given. The work and organization of the Local Authority Radiation Monitoring Advice and Cellation Centre (LARMACC), a company formed to aid the local authorities carry out their objectives, are described. They provide the following

information to their members: background gamma dose rate as nationwide averages over a 120 km grid and as monthly variations for 12 regions; details of analyses of environmental materials such as soil, sand, silt, grass and seaweed; details of analyses of airborne particulates such as calculation of committed effective dose based on dose equivalents and average and critical group inhalation rates; details of analyses of food for humans and animals and water including local and imported produce, and concentrations of isotopes in food groups; details of tests of imported materials of all types; committed effective dose to a one year old, a ten year old and an adult based in committed effective dose equivalents and the average and critical consumptions rates; reference data including a list of generalized derived limits, emergency reference levels and European Standards. The aim of the quality system carried out by LARMACC is for all forms of local authority radiation monitoring to satisfy the requirements laid down in the NAMAS M10 and M16 documents. There is a general quality manual that formalizes the quality system and is designed for use by all local authorities. It describes aspects of the technical contractor's responsibilities and indicates that annual audits will be carried out. ESA

N92-25536 National Physical Lab., Teddington (England).
NAMAS UPDATE **c72**
I. W. Goodier *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 14-15 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

An outline of the 'NAMAS update' talk is given. Details of calibrated and testing laboratories that have been accredited by NAMAS in the radiological field are given. The customers of 'NAMAS ' accredited laboratories can be assured of the following: the competence of the laboratory has been assessed by independent, expert assessors; all the measurements performed are traceable to the national standards of measurements at NPL; the laboratories have performed their measurements in a technically sound way; the laboratories operate an approved quality system and therefore quality measurements are made at all times and not just on special occasions; the uncertainties of measurements quoted by the laboratories have been assessed and can be substantiated. ESA

N92-25550# Radian Corp., Research Triangle Park, NC.
ENHANCED OZONE MONITORING NETWORK DESIGN AND SITING CRITERIA GUIDANCE DOCUMENT
Nov. 1991 69 p
(Contract EPA-68-DO-0125)
(PB92-145390; EPA/450/4-91/033) Avail: NTIS HC/MF A04

New ozone monitoring sites are required by the Clean Air Act Amendments (CAAA) to enhance the existing ambient air monitoring network currently composed of State and Local Air Monitoring Stations (SLAMS), the National Air Monitoring Stations (NAMS), and Special Purpose Monitors (SPM) stations. These enhanced monitoring sites, called photochemical assessment monitoring stations (PAMS), will measure ozone, volatile organic compounds (VOC) (including aldehydes), NOx concentrations, and meteorological parameters. As the PAMS will become part of the SLAMS network, they will be subject to specific siting, quality assurance, analytical methodology, sampling interval, and instrument requirements. The guidance document provides a description of the PAMS sites, and the requirements for siting and configuring the sites. GRA

N92-25745# Lawrence Livermore National Lab., CA.
CHAMMP PROGRAM OVERVIEW
M. C. MacCracken Oct. 1991 6 p Presented at the ARM Science Team Conference, Denver, CO, 26-30 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008063; UCRL-JC-109518; CONF-9110336-1) Avail: NTIS HC/MF A02

CHAMMP is an integral part of the ESD climate modeling program and its objectives are highly complementary to the modeling activities being conducted as part of the Program for Climate Model Diagnosis and Intercomparison. CHAMMP is also closely linked to the US Global Change Research Program, especially through its interactions with the major climate modeling centers of the other agencies. Because of its need for and focus on use of forefront supercomputers, CHAMMP is also a contributing program in the High Performance Computing Program, which is a new Presidential Initiative dedicated to the 'grand challenge' computational problems. Just as the ARM program was formed in recognition of the inability of present general circulation models (GCMs) to satisfactorily represent cloud formation, convection, and radiative processes, the CHAMMP program was organized in response to the need to harness greater computational power in the pursuit of regionally resolved projections of climate change. The goal of the CHAMMP Climate Modeling Program is to develop, verify, and apply a new generation of climate models within a coordinated framework that incorporates the best available scientific and numerical approaches to represent physical, biogeochemical, and ecological processes, that fully utilizes the hardware and software capabilities of new computer architectures, that probes the limits of climate predictability, and finally that can be used to address the challenging problem of understanding the greenhouse climate issue through the ability of the models to simulate time-dependent climatic changes over extended times and with regional resolution. DOE

N92-26000# Lawrence Livermore National Lab., CA.
GLACIAL TERMINATIONS AND THE GLOBAL WATER BUDGET
W. S. Broecker (Lamont-Doherty Geological Inst., Palisades, NY.)
Jan. 1992 50 p
(Contract W-7405-eng-48)
(DE92-008939; UCRL-CR-109709) Avail: NTIS HC/MF A03

Evidence suggests that the last glacial period came to an abrupt close about 13,500 years ago. This evidence indicates: (1) that the melting of the North American ice sheet commenced abruptly at this time; (2) that surface temperatures in the northern Atlantic rose sharply at this time; (3) that surface water conditions in the Antarctic changed abruptly at this time; (4) that the salinity of the Red Sea dropped abruptly at this time; and (5) that accumulation rate of planktonic foraminifera in the South China Sea underwent an abrupt five-fold increase at this time. This project was directed toward better developing and documenting our explanation for the abruptness of these changes. This project has supported investigation of several aspects of this hypothesis. We suggest that the Greenland climate changes are driven by oscillations in salt content which modulate the strength of the Atlantic's conveyor circulation. DOE

N92-26090# California Univ., Berkeley. Lawrence Berkeley Lab. Chemical Sciences Div.
[RESEARCH ACTIVITIES OF THE CHEMICAL SCIENCES DIVISION] Annual Report, 1990
Aug. 1991 90 p
(Contract DE-AC03-76SF-00098)
(DE92-009136; LBL-30460) Avail: NTIS HC/MF A05

This report presents papers that were puplished in the last twelve months by researchers in the Chemical Science Division of the Lawrence Berkeley Laboratory. The following topics were covered: photochemistry of materials in the stratosphere, energy transfer and structural studies of molecules on surfaces, crossed molecular beams, molecular interactions, theory of atomic and molecular collision processes, selective photochemistry, photodissociation of free radicals, physical chemistry with emphasis on thermodynamic properties, chemical physics at the high photon energies, high-energy atomic physics, atomic physics, high-energy oxidizers and delocalized-electron solids, catalytic hydrogenation of CO, transition metal-catalyzed conversion of CO, NO, H2, and organic molecules to fuels and petrochemicals, formation of oxyacids of sulfur from SO2, potentially catalytic and conducting polyorganometallics, actinide chemistry, and molecular thermodynamics for phase equilibria in mixtures. DOE

N92-26121*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE FUTURE OF SPACEBORNE ALTIMETRY. OCEANS AND CLIMATE CHANGE: A LONG-TERM STRATEGY
C. J. Koblinsky, ed., P. Gaspar, ed., and G. Lagerloef, ed. (Science Applications International Corp., Bellevue, WA.) Mar. 1992 82 p Original contains color illustrations
(NASA-TM-105087; NAS 1.15:105087) Avail: NTIS HC/MF A05; 19 functional color pages

The ocean circulation and polar ice sheet volumes provide important memory and control functions in the global climate. Their long term variations are unknown and need to be understood before meaningful appraisals of climate change can be made. Satellite altimetry is the only method for providing global information on the ocean circulation and ice sheet volume. A robust altimeter measurement program is planned which will initiate global observations of the ocean circulation and polar ice sheets. In order to provide useful data about the climate, these measurements must be continued with unbroken coverage into the next century. Herein, past results of the role of the ocean in the climate system is summarized, near term goals are outlined, and requirements and options are presented for future altimeter missions. There are three basic scientific objectives for the program: ocean circulation; polar ice sheets; and mean sea level change. The greatest scientific benefit will be achieved with a series of dedicated high precision altimeter spacecraft, for which the choice of orbit parameters and system accuracy are unencumbered by requirements of companion instruments. Author

N92-26140# California Univ., Berkeley.
CO2 EMISSIONS FROM DEVELOPING COUNTRIES: BETTER UNDERSTANDING THE ROLE OF ENERGY IN THE LONG TERM
A. Ketoff, ed., J. Sathaye, ed., and N. Goldman, ed. Jul. 1991 77 p
(Contract DE-AC03-76SF-00098)
(DE92-009503; LBL-30059) Avail: NTIS HC/MF A05

Recent years have witnessed a growing recognition of the link between emissions of carbon dioxide (CO2) and changes in the global climate. Of all anthropogenic activities, energy production and use generate the single largest portion of these greenhouse gases. Although developing countries currently account for a small share of global carbon emissions, their contribution is increasing rapidly. Due to the rapid expansion of energy demand in these nations, the developing world's share in global modern energy use rose from 16 to 27 percent between 1970 and 1990. If the growth rates observed over the past 20 years persist energy demand in developing nations will surpass that in the countries of the Organization for Economic Cooperation and Development (OECD) early in the 21st century. The study seeks to examine the forces that galvanize the growth of energy use and carbon emissions, to assess the likely future levels of energy and CO2 in selected developing nations and to identify opportunities for restraining this growth. The purpose of this report is to provide the quantitative information needed to develop effective policy options, not to identify the options themselves. These individual studies were conducted for Argentina, Brazil, Mexico and Venezuela in Latin America. DOE

N92-26154 National Inst. for Occupational Safety and Health, Cincinnati, OH.
EVALUATION OF ALTERNATIVE SAMPLERS FOR BIOAEROSOLS. PHASE 1: PHYSICAL SAMPLING EFFICIENCY
K. F. Martinez, W. F. Todd, and T. J. Fischbach 12 Mar. 1991 54 p Prepared in cooperation with Environmental Protection Agency, Cincinnati, OH
(PB92-161918; CT-160-04A) Avail: NTIS HC/MF A04

The sampling efficiencies of the Biotest centrifugal sampler, the SAS (surface air sampler), the Andersen two stage sampler, and the Andersen single stage sampler with the membrane filter sampler were compared for use in assessing potential exposures to microorganisms in biotechnology based production facilities. Each sampler was challenged with a microbial surrogate aerosol under controlled conditions in a horizontal chamber designed for the study of aerosol samplers. The findings indicated that the Andersen two stage sampler differed from the other samplers except for the reference sampler, the filter cassette, in terms of the level of measurement on the average and by particle size level. The Andersen single stage sampler under sampled the reference sampler by -47 percent. The Biotest and the SAS sampler both under sampled the reference sample by -81 and -57 percent, respectively. There was not a statistical difference among particle size ranges for the bias of the Biotest sampler. However, there was a statistical difference among particle size ranges for the bias of the SAS sampler. Author

N92-25766# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
GLOBAL OZONE MONITORING BY OCCULTATION OF STARS (GOMOS)
Seppo Korpela, Erkki Kyroelae, Risto Pellinen, Tapio Tuomi, Ville Sipinen, Vaeinoe Kelhae, Gilbert Leppelmeier, Kai Maekisara, Heikki Saari, and Kai Haemaelaeinen (Hollming Oy Elektroniikka, Tampere, Finland) et al *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 15-16; In FINNISH; ENGLISH title (For primary document see N92-25758 16-88) Avail: NTIS HC/MF A05
Avail: NTIS HC/MF A05

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-25146*# Eloret Corp., Sunnyvale, CA.
IMPACT CONTRIBUTION OF PREBIOTIC REACTANTS TO EARTH Technical Report, 1 Jan. - 31 Dec. 1992
Hans R. Aggarwal 5 Mar. 1992 30 p
(Contract NCC2-722)
(NASA-CR-190068; NAS 1.26:190068) Avail: NTIS HC/MF A03

It is proposed that the AIB amino acids at the K/T boundary were synthesized during entry of a comet. However, whether they were synthesized or supplied directly from space, the concentration of amino acids in the shallow K/T sea would have been about 10(exp -7) M. It is probable that clays were the dominant sinks for the amino acids in the K/T sea and in the primordial ocean. Because clay removed amino from the sea so quickly, we must study the amino acid contribution from individual comets in order to evaluate the effectiveness of comets for chemical evolution. Such an evaluation shows that comets would have produced amino acid concentrations higher than equilibrium concentrations of amino acids from corona discharge at all times preceding the age of the oldest fossils. The preferred sites for chemical evolution of cometary amino acids are in cloud drops and tide pools where the concentration of amino acids would have been the highest. Life could have originated at the surface even during periods of intense bombardment of the earth before 3.8 billion years ago. Author

N92-25188 Royal Netherlands Meteorological Inst., De Bilt.
A PARAMETRIZATION OF THE CONVECTIVE ATMOSPHERIC BOUNDARY LAYER AND ITS APPLICATION INTO A GLOBAL CLIMATE MODEL
A. A. M. Holtslag, B. A. Boville, and C.-H. Moeng (National Center for Atmospheric Research, Boulder, CO.) 1991 30 p Presented at the Workshop on Fine-Scale Modeling and the Development of Parametrization Schemes, Reading, England, 16-18 Sep. 1991 Sponsored in part by NCAR
(KNMI-WR-91-01; ISBN-90-369-2005-1; ISSN-0169-1651; ETN-92-91700) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Netherlands

Vertical diffusion of heat and passive scalars (like moisture) in the convective atmospheric boundary layer are focused upon. Flux equations are analyzed with data obtained from large eddy

simulations. The findings can be used in a modified flux gradient approach, which takes into account the nonlocal convective vertical exchange using the so called counter gradient transport and a nonlocal diffusivity coefficient. Previous findings are simplified and applied to a community climate model. The impact of the nonlocal approach is illustrated in comparison with the usual local diffusion approach. ESA

N92-25193*# Columbia Univ., New York, NY.
CLIMATE AND ATMOSPHERIC MODELING STUDIES Semiannual Progress Report, 1 Sep. 1991 - 31 Mar. 1992
Apr. 1992 21 p
(Contract NCC5-29)
(NASA-CR-190186; NAS 1.26:190186) Avail: NTIS HC/MF A03

The climate and atmosphere modeling research programs have concentrated on the development of appropriate atmospheric and upper ocean models, and preliminary applications of these models. Principal models are a one-dimensional radiative-convective model, a three-dimensional global model, and an upper ocean model. Principal applications were the study of the impact of CO2, aerosols, and the solar 'constant' on climate. Author

N92-25369*# Space Physics Research Inst., Sunnyvale, CA.
MODELLING ATMOSPHERIC SCATTERERS USING SPACECRAFT OBSERVATIONS Semiannual Status Report, 1 Oct. 1991 - 31 Mar. 1992
Kathy A. Rages 31 Mar. 1992 27 p
(Contract NCC2-662)
(NASA-CR-190263; NAS 1.26:190263) Avail: NTIS HC/MF A03

Voyager images of Triton indicate considerable spatial variability in the concentration of at least two different scattering components in the atmosphere. Data from high phase angle limb scans were fit to Mie scattering models to derive mean particle sizes, number densities, and vertical extent for both types of scattering material at ten different locations between 15 deg S and 70 deg S. These fits reveal a thin haze at latitudes equatorward of 25-30 deg S. The imaging data can be fit reasonably well by both conservatively scattering and absorbing hazes with particle sizes near 0.18 micron and optical depths of order 0.001-0.01. Rayleigh scattering haze fits the imaging data somewhat less well, and can be totally ruled out by combining the imaging and UVS measurements. At high southern latitudes, Triton displays clouds below an altitude of approximately 8 km, as well as the haze at higher altitudes. The clouds have particle sizes which may range from 0.7-2.0 microns, or may be near 0.25 micron. The atmospheric optical depth poleward of 30 deg S must be generally greater than 0.1, but need not be more than 0.3. Horizontal inhomogeneities are quite noticeable, especially at longitudes east of (i.e., higher than) 180 deg. Author

N92-25517# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
THEORETICAL PROBLEMS IN NONSYMMETRIC GRAVITATIONAL THEORY
T. Damour, S. Deser, and J. McCarthy Dec. 1991 7 p Prepared in cooperation with Brandeis Univ., Waltham, MA
(Grant NSF PHY-88-04561)
(PB92-152321; IHES/P/91/82) Avail: NTIS HC/MF A02

It has recently been noted that the nonsymmetric metric model of gravity encounters observational problems. It is shown that it is also untenable even as an effective field theory, due to curvature-coupled ghost modes and associated loss of acceptable asymptotic behavior. GRA

N92-25529# Environmental Protection Agency, Washington, DC. Office of Toxic Substances.
DETERMINATION OF RATES OF REACTION IN THE GAS-PHASE IN THE TROPOSPHERE. THEORY AND PRACTICE. PART 4: RATE OF INDIRECT PHOTOREACTION
A. Leifer 20 Feb. 1992 79 p
(PB92-150382; EPA/700/R-92/003) Avail: NTIS HC/MF A05

The document describes a test guideline (section 796.3900) which can be used under sections four and five of the Toxic Substances Control Act (TSCA) to regulate industrial chemicals. It describes structure/reactivity (S/R) relationships of Atkinson of the University of California/Riverside for estimating the second order rate constant of k(OH) and the associated half life t(sub 0.5)E for the reaction of an organic chemical with hydroxyl radicals in the gas phase in the troposphere. All pertinent parameters and equations are listed in the report to enable a scientist to calculate k(OH) and t(sub 0.5)E. Sixteen organic chemicals, covering a range of molecular structures, are used to illustrate the use of S/R relationships of Atkinson to estimate k(OH). A hypothetical example is given to illustrate the use of these S/R relationships to define testing under section four of TSCA. A mathematical synopsis of the S/R relationships of Atkinson is given in section four of the report. GRA

N92-25557 Alaska Univ., Fairbanks.
A THEORETICAL STUDY OF MAGNETOSPHERE-IONOSPHERE COUPLING PROCESSES Ph.D. Thesis
Fei Cao 1991 171 p
Avail: Univ. Microfilms Order No. DA9209699

Magnetosphere and ionosphere are coupled electrodynamically by waves, field aligned currents and parallel electric fields. Several fundamental coupling processes are addressed. It is shown that the Alfven wave is the dominant mode in transmitting field aligned currents. Therefore, dynamic M-I coupling can be modeled by the Alfven wave bouncing between the ionosphere and magnetospheric boundaries. The open magnetopause, separating the solar wind and the magnetosphere, behaves like a near perfect reflector to the Alfven wave because of the large solar wind inertia. At the plasma sheet, however, the reflection coefficient may extend over a wide range, depending on the location in the plasma sheet. As the Alfven wave propagates back and forth between the magnetosphere and ionosphere, the field aligned current density increases dramatically at certain locations, especially near the head of the westward traveling surge, causing potential drops to develop along magnetic field lines. It is found that the existence of parallel potential drops can distort the global convection pattern and limit the upward field aligned current. The magnetic reconnection at the dayside magnetopause is responsible for enhancing the convection in the magnetosphere, which subsequently propagates toward the ionosphere by the Alfven wave. The patchy and intermittent reconnection at the dayside magnetopause can be initiated by the 3-D tearing instability, leading to the isolated magnetic islands and X line segments. The nonlinear evolution of tearing in terms of the magnetic island coalescence is also studied. Dissert. Abstr.

N92-25583 California Univ., San Diego.
THE LARGE-SCALE STRUCTURE OF THE DEEP EARTH AS CONSTRAINED BY FREE OSCILLATION OBSERVATIONS Ph.D. Thesis
Rudolf Widmer 1991 170 p
Avail: Univ. Microfilms Order No. DA9202611

Large earthquakes are capable of exciting the elasto-gravitational free oscillations of the Earth to a detectable level. Recordings of such earthquakes from the last 16 years are used to observe the resonance frequencies of the Earth. Given that the deviations from spherical symmetry are small, the determination of the large-scale mechanical structure of the Earth separates into two problems. Observations from spherical symmetry can be constrained by observations of mode splitting. Chapter two reports observations of the degenerate frequencies of 600 spheroidal and toroidal multiplets with frequencies less that 10 MHz. In chapter three, we use two techniques, which explicitly take the effect of large-scale aspherical structure ito account to estimate degenerate frequency and axisymmetric degree 2 structure coefficients of 10 core-sensitive multiplets in the frequency band 5-10 MHz. In chapter four, we use recordings of the 1989 Macquarie rise earthquake to analyze the lowest order fundamental toroidal modes and we report the first unambiquous observation of the gravest toroidal mode sub 0 T sub 2. Chapter five discusses the use of observations of the attenuation of free oscillations to

infer the depth dependence of the intrinsic attenuation. Chapter six critically summarizes the data set constraining spherically symmetric Earth structure. Dissert. Abstr.

N92-25586 Michigan Univ., Ann Arbor.
STUDYING NONLINEAR EQUATORIAL DYNAMICS WITH A SPECTRAL ELEMENT SHALLOW WATER EQUATION MODEL AND INTERNAL GRAVITY WAVE GUIDE IN BOUNDARY CURRENT Ph.D. Thesis
Hong Ma 1991 226 p
Avail: Univ. Microfilms Order No. DA9208609

A spectral element shallow water equation model has been built in the first part of this dissertation. Applying it in the simulation of the equatorial ocean response to a Rossby wave vortex pair, we find that the cyclonic equatorial Rossby wave vortex pair can cause significant nonlinear instabilities in the western boundary region while it is reflected from there. As a result, the dynamic and kinetic structures in the western part of the ocean are totally different from those in the cases dominated by linear dynamics. Moreover, an extra amount of the energy flux carried by the long waves is permanently lost to the high order short Rossby waves due to the long-short wave interactions in the western boundary region. Therefore, the strong nonlinearity has further reduced the effectiveness of the western boundary in reflecting the long Rossby wave signals. The simulation results also show that the phase speeds of the equatorial long Rossby wave and the equatorial Kelvin wave of depression, which correspond to the thermocline shoaling, are smaller in the nonlinear simulations than those in the linear case. The simulation with low Reynolds number shows that high horizontal eddy viscosity can severely suppress the nonlinear instability. The simulation results with R sub e = 200 are largely explainable by the linear theory. Dissert. Abstr.

N92-25588 Michigan Univ., Ann Arbor.
A NUMERICAL STUDY OF CAPILLARY-GRAVITY WAVES Ph.D. Thesis
Jin Huh 1991 149 p
Avail: Univ. Microfilms Order No. DA9208560

Surface tension provides a restoring force which cannot be ignored for water waves of short wavelengths. Even for large wavelengths its presence precludes any sharp corner developing on the free surface. Here, the effects of surface tension on steep water waves are investigated numerically; the periodic progressive capillary-gravity waves under resonant conditions and their time-marching results are discussed as well as wave breaking behaviors due to the energetic initial conditions and the submerged disturbances. A spectral boundary technique with kernel desingularization gives better results for most test cases than the alternating point integration scheme and the piecewise-linear method. This spectral representation is very accurate when the geometry is smooth and nodal spacing is uniform. Wave breaking behaviors due to the energetic initial conditions and moving submerged dipole array were investigated using this scheme. We found that for wave amplitude ak greater than 0.27 the waves will break and for ak less than 0.27 waves will progress indefinitely, when simple harmonic initial conditions are used. A spilling breaker is formed when ak is small and larger values of ak form plunging breakers. The geometries of these breaking waves match well to Bonmarin's experiments (1989). We also found that the potential energy is a better criterion than peak-to-peak wave height to determine whether traveling waves will break. When periodic dipole arrays are towed at constant speed, we find that breaking is suppressed by slower dipole speed, deeper dipole depth or weaker dipole strength. Most importantly, we find that breaking is suppressed by surface tension. Dissert. Abstr.

N92-25803# Naval Postgraduate School, Monterey, CA.
SURVEY OF TRAPPED PLASMAS AT THE EARTH'S MAGNETIC EQUATOR M.S. Thesis
Peter G. Braccio Dec. 1991 89 p
(AD-A245773) Avail: NTIS HC/MF A05

Analysis of data from the HPCE experiment on the AMPTE/CCE satellite established probability distributions for trapped ions and electrons. Trapped 150 eV electrons occurred primarily in the dawn to noon local time sector, centered at L = 6. Trapped 50-150 eV ion distributions show strong L versus local time dependence, but are primarily found on the dayside (the dusk sector was not sampled for ions in this survey). This local time dependence appears to reflect the L versus local time dependence of the plasmapause. The regions of peak occurrence probability for trapped ions were mutually exclusive with the high probability regions of trapped electrons. This offset in the location of trapped plasma species was seen frequently on a daily basis as well as in the statistical survey. GRA

N92-25998# Oak Ridge National Lab., TN.
MHD-EMP PROTECTION GUIDELINES
P. R. Barnes and E. F. Vance 1992 6 p Presented at the 1992 Hardened Electronics and Radiation Technology (HEART) Conference, Albuquerque, NM, 24-28 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-008898; CONF-920223-4) Avail: NTIS HC/MF A02

A nuclear detonation at altitudes several hundred kilometers above the earth will severely distort the earth's magnetic field and result in a strong magnetohydrodynamic electromagnetic pulse (MHD-EMP). The geomagnetic disturbance interacts with the soil to induce current and horizontal electric gradients. MHD-EMP, also called E3 since it is the third component of the high-altitude EMP (HEMP), lasts over 100 s after an exoatmospheric burst. MHD-EMP is similar to solar geomagnetic storms in it's global and low frequency (less than 1 Hz) nature except that E3 can be much more intense with a far shorter duration. When the MHD-EMP gradients are integrated over great distances by power lines, communication cables, or other long conductors, the induced voltages are significant. (The horizontal gradients in the soil are too small to induce major responses by local interactions with facilities.) The long pulse waveform for MHD-EMP-induced currents on long lines has a peak current of 200 A and a time-to-half-peak of 100 s. If this current flows through transformer windings, it can saturate the magnetic circuit and cause 60 Hz harmonic production. To mitigate the effects of MHD-EMP on a facility, long conductors must be isolated from the building and the commercial power harmonics and voltage swings must be addressed. The transfer switch would be expected to respond to the voltage fluctuations as long as the harmonics have not interfered with the switch control circuitry. The major sources of MHD-EMP induced currents are the commercial power lines and neutral; neutral current indirect coupling to the facility power or ground system via the metal fence, powered gate, parking lights, etc; metal water pipes; phone lines; and other long conductors that enter or come near the facility. The major source of harmonics is the commercial power system. DOE

N92-25768# Oulu Univ. (Finland). Dept. of Physics.
ION COMPOSITION IN THE MAGNETOSPHERE: RECENT OBSERVATIONS OF ENERGETIC He(+) AND He(++) IONS BY AMPTE/CCE
Gerhard Kremser *In its* Second Meeting of Finnish Space Researchers 1990 p 21-22 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25770# Oulu Univ. (Finland). Dept. of Mechanical Engineering.
THE EFW EXPERIMENT FOR THE CLUSTER SATELLITE PROGRAM
Kauko Lappalainen, Kalevi Mursula, Jorma Pulkkinen, Reijo Rasinkangas, and Pekka Tanskanen *In its* Second Meeting of Finnish Space Researchers 1990 p 25 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-25270# Lawrence Livermore National Lab., CA.
A STUDY OF SEASONAL CLIMATE PREDICTION WITH A SIMPLE COUPLED OCEAN-ATMOSPHERE MODEL
T. J. Phillips Nov. 1991 7 p Presented at the 16th Annual Climate Diagnostic Workshop, Lake Arrowhead, CA, 28 Oct. - 1 Nov. 1991
(Contract W-7405-eng-48)
(DE92-007335; UCRL-JC-108864; CONF-9110279-2) Avail: NTIS HC/MF A02

Comprehensive data from future satellite initiatives such as EOS will make it possible to predict (by statistical, if not dynamical methods) seasonal atmospheric climate from knowledge of the state of the world's oceans. However, many questions (e.g., what ocean variables are superior climate predictors and what atmospheric variables can be predicted most readily) remain to be answered before global seasonal climate prediction can be a practical endeavor. Because time series of existing global data from both observations and general circulation models (GCMs) are too short to provide these answers with statistical confidence, it is appropriate to use simpler models for preliminary studies of seasonal climate prediction. Then, as more global data become available, these issues can be revisited from a more advanced starting point. A simple model consisting of a mixed-layer ocean coupled synchronously to a two-layer atmosphere was used for the present study. DOE

N92-25331*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AN ATLAS OF UPPER TROPOSPHERIC RADIANCES OBSERVED IN THE 6 TO 7-MICROMETER WATER VAPOR BAND USING TOVS DATA FROM THE NOAA WEATHER SATELLITES DURING 1979-1991
Dennis Chesters and Om Sharma (Research and Data Systems, Inc., Lanham, MD.) May 1992 186 p
(NASA-TM-104563; Rept-92B00081; NAS 1.15:104563) Avail: NTIS HC/MF A09

This document is a pictorial atlas of the Earth's radiance emitted in the 6 to 7 micro-m water vapor band. At these wavelengths, the infrared brightness temperature corresponds to the layer-average temperature of the top few millimeters of water vapor in the atmosphere. At low altitudes, bright regions are dry slots in the upper troposphere. The satellite observations were obtained from NOAA's cloud and angle corrected measurements made by a series of polar orbiting TOVS (TIROS Operational Vertical Sounder) instruments flown from 1979 to 1991. TOVS 6.7 micro-m and 7.2 micro-m channels were converted to a single brightness temperature that simulates a high altitude channel near '6.5' micro-m. For climatological studies, the daily '6.5' micro-m overpass data were gridded to a cartesian projection with 5 by 5 degree horizontal resolution between 40 degrees N and 40 degrees S latitude. This atlas presents greyscale images of the '6.5' micro-m brightness fields for every day in every month for 13 years. The mean brightness for each of the 12 months for 13 years is presented to display interannual variability, and the annual cycle of 12 monthly means is summarized on a single page. Statistical summaries are presented from other investigations in progress.
Author

N92-25466*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PERFORMANCE MODELING OF ULTRAVIOLET RAMAN LIDAR SYSTEMS FOR DAYTIME PROFILING OF ATMOSPHERIC WATER VAPOR
R. A. Ferrare, D. N. Whiteman, S. H. Melfi, J. E. M. Goldsmith, S. E. Bisson, and M. Lapp (Sandia National Labs., Albuquerque, NM.) 1991 8 p Presented at the CLEO/QELS '92, Anaheim, CA, 10-17 May 1992
(Contract DE-AC04-76DR-00789)
(NASA-TM-107789; NAS 1.15:107789; DE92-006701-4; SAND-91-8749; CONF-920573-4) Avail: NTIS HC/MF A02

We describe preliminary results from a comprehensive computer model developed to guide optimization of a Raman lidar system for measuring daytime profiles of atmospheric water vapor, emphasizing an ultraviolet, solar-blind approach. DOE

N92-25472# International Centre for Theoretical Physics, Trieste (Italy).
ESTIMATION OF PRECIPITABLE WATER FROM SURFACE DEW POINT TEMPERATURE
M. AbdelWahab and T. A. Sharif (Alfateh Univ., Tripoli, Libya) Sep. 1991 11 p
(DE92-619047; IC-91/284) Avail: NTIS HC/MF A03

The Reitan (1963) regression equation which is of the form natural log of w = a + bT(sub b) has been examined and tested to estimate precipitable water content from surface dew point temperature at different locations. The study confirms that the slope of this equation (b) remains constant at the value of .0681 C, while the intercept (a) changes rapidly with the latitude. The use of the variable intercept can improve the estimated result by 2 percent. DOE

N92-25476# New Mexico State Univ., Las Cruces. Water Resources Research Inst.
RIO GRANDE BASIN GLOBAL CLIMATE CHANGE SCENARIOS: PROCEEDINGS OF WORKSHOPS AND CONFERENCE
W. Stone, M. Minnis, and E. Trotter Jun. 1991 127 p Workshops and Conference held in Albuquerque, NM, 1-2 Jun. 1990 Sponsored in part by Sandia National Labs, Albuquerque, NM; and Bureau of Land Management, Albuquerque, NM
(PB92-106293; WRRI-M24) Avail: NTIS HC/MF A07

Conference topics discussed include regional aspects of climate change, approaches to the problem, information and research needs, organizational and political perspectives, and funding.
Author

N92-25493*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ATMOSPHERIC WATER VAPOR MEASUREMENTS DURING THE SPECTRE CAMPAIGN USING AN ADVANCED RAMAN LIDAR
S. H. Melfi, D. N. Whiteman, R. A. Ferrare, S. E. Bisson, J. E. M. Goldsmith, and M. Lapp (Sandia National Labs., Albuquerque, NM.) 1991 6 p Presented at the CLEO/QELS '92, Anaheim, CA, 10-17 May 1992
(Contract DE-AC04-76DR-00789)
(NASA-TM-107822; NAS 1.15:107822; DE92-006703; SAND-91-8751; CONF-920573-5) Avail: NTIS HC/MF A02

Water vapor is an important atmospheric state variable. From a dynamics stand point its distribution with height determines convective stability, which in turn controls storm development. From a radiative perspective, current global warming scenarios suggest that water vapor may contribute as much as twice the anticipated atmospheric temperature increase that would be caused by anthropogenic carbon dioxide along via a thermally induced feedback mechanism. Because atmospheric water vapor is radiatively active, accurate measurements with high spatial and temporal resolution are required to fully understand it's impact on future global surface temperature. An advanced Raman lidar has been designed to operate in both daylight and darkness. Details of the instrument will be presented. Results from operating during the SPECTRE Field Campaign will be discussed. DOE

N92-25564 Missouri Univ., Columbia.
OCCLUDOGENESIS IN SIMULATED CYCLONES Ph.D. Thesis
Mikdat Kadioglu 1991 312 p
Avail: Univ. Microfilms Order No. DA9209949

The process of occluded frontogenesis is studied through integration of the hydrostatic Boussinesq formulation of the primitive equations, using a cyclic, baroclinic, adiabatic, beta-plane channel model. There is no orography. This three-dimensional, non-linear model employs horizontal and vertical resolution of 100 km and 0.5 km, respectively; an integration uses 30 levels in the vertical,

with 54 and 62 grid points in the east-west and north-south directions, respectively. The most unstable normal modes of wave numbers one and two, as determined by the linear perturbation equations, are adapted as initial disturbances to simulate two extratropical cyclones on the midlatitude, baroclinic westerly jet. We run two basic experiments, each with and without friction. We observe that, for all 4 integrations, the cyclones undergo an occlusion process and occluded fronts form, all having a similar structure, that of 'back to back' fronts. All 4 integrations also produce similar deformation and convergence patterns, for the developing cyclones. In the no friction simulations, warm air enters the cyclone center, and a cold front catches up to the warm front. The cold front may be fractured near the cyclone center as the cold air approaches the warm tongue from the southwest. In the friction simulations, due to weaker advection, warm air does not reach the cyclone center before the cyclone occludes. Cold and warm fronts have formed south of the cyclone center; as the frontal cusp moves away from the center, an occluded front forms north of the cusp, in the pre-existing region of convergence, where enhanced vorticity and reduced stability already are present. The cold front does not catch up to the warm front during occluded frontal formation. No riding up of one front over the other is observed in the occluded fronts. Dissert. Abstr.

N92-25565 Michigan Univ., Ann Arbor.
AN INVESTIGATION OF THE ARCHEAN CLIMATE USING THE NCAR CCM Ph.D. Thesis
Gregory Stephen Jenkins 1991 169 p
Avail: Univ. Microfilms Order No. DA9208569

The Archean (2.5 to 3.8 billion years ago) is of interest climatically, because of the 'Faint-Young Sun Paradox', which can be characterized by the Sun's reduced energy output. This lower energy output leads to a frozen planet if the climate existed as it does today. But, the geologic record shows that water was flowing at the earth's surface 3.8 billion years ago. Energy Balance Models (EBMs) and one-dimensional radiative-convective (1DRC) models predict a frozen planet for this time period, unless large carbon dioxide (CO2) concentrations exist in the Archean atmosphere. The goal is to explore the Archean climate with the National Center for Atmospheric Research (NCAR), Community Climate Model (CCM). The search for negative feedbacks to explain the 'Faint-Young Sun Paradox' is the thrust of this study. This study undertakes a series of sensitivity simulations which first explores individual factors that may be important for the Archean. They include rotation rate, lower solar luminosity, and land fraction. Then, these climatic factors along with higher CO2 concentrations are combined into a set of experiments. A faster rotation rate may have existed in the Archean. The faster rotation rate simulations show warmer globally averaged surface temperatures that are caused by a 20 percent decrease in the total cloud fraction. The smaller cloud fraction is brought about by dynamical changes. A global ocean is a possibility for the Archean. A global ocean simulation predicts 4 K increase in global mean surface temperatures compared to the present-day climate control.
Dissert. Abstr.

N92-25587 Arizona Univ., Tucson.
REMOTE SENSING THE SUSCEPTIBILITY OF CLOUD ALBEDO TO CHANGES IN DROP CONCENTRATION Ph.D. Thesis
Steven Edward Platnick 1991 266 p
Avail: Univ. Microfilms Order No. DA9208031

The role of clouds in reflecting solar radiation to space and thereby reducing surface heating is of critical importance to climate. Combustion processes that produce greenhouse gases also increase cloud condensation nuclei (CCN) concentrations which in turn increase cloud drop concentrations and thereby cloud albedo. A calculation of cloud susceptibility, defined in this work as the increase in albedo resulting from the addition of one cloud drop per cubic centimeter (as cloud liquid water content remains constant), is made through satellite remote sensing of cloud drop radius and optical thickness. The remote technique uses spectral channels of the Advanced Very High Resolution Radiometer (AVHRR) instrument on board the NOAA polar orbiting satellites. Radiative transfer calculations of reflectance and effective surface and cloud emissivities are made for applicable sun and satellite viewing angles, including azimuth, at various radii and optical thicknesses for each AVHRR channel. Emission in channel 3 (at 3.75 microns) is removed to give the reflected solar component. These calculations are used to infer the radius and optical thickness giving the best match to the satellite measurements. The effect of the atmosphere on the signal received by the satellite is included in the analysis. Dissert. Abstr.

N92-26010# Mitre Corp., McLean, VA.
PERSISTENCE IN CLIMATE
G. MacDonald Feb. 1992 66 p
(Contract DE-AI05-90ER-30174)
(DE92-009702; JSR-91-340) Avail: NTIS HC/MF A04

Persistence in weather forecasting is used to describe runs of several days with similar weather characteristics. This general notion of persistence is extended to long term records of climate by examining the scaling properties of the range, maximum minus minimum, of the integral or sum of observed or calculated variable. The values of persistence, P, are limited by existence considerations to -1 less than or = P less than or = 1. For P = O, the increments making up the sum are uncorrelated, independent variables. Values of P near unity represent a tendency for long runs of similar values. Observed global average annual temperature records exhibit strong positive persistence even when linear trend is removed. A hundred year CCM run (CCM-1) shows vanishing persistence perhaps indicating that the real oceans give rise to runs of several years of decades with similar climate characteristics while the model ocean fixed by seasonal means does not. DOE

N92-26103# Army Lab. Command, White Sands Missile Range, NM. Atmospheric Sciences Lab.
A METHOD FOR ESTIMATING SIMILARITY SCALING AND OBUKHOV LENGTHS FROM DISCRETE VERTICAL PROFILE DATA Final Report
Henry Rachele, Arnold Tunick, and Frank V. Hansen Dec. 1991 31 p
(AD-A245823; ASL-TR-0303) Avail: NTIS HC/MF A03

Many schemes have been developed to transform discrete meteorological vertical profile data into continuous forms. However, problems with fitting highly nonlinear equations such as similarity formulations to discrete values of wind, temperature, and specific humidity in the surface boundary layer still exist, since the data deviates from the smooth theoretical profiles due to natural fluctuations and instrument errors. The authors have compared the results of the tried-and-true method with the results of their method that is based on the mean value theorem of calculus. The authors have dealt with the unstable, stable, and neutral cases, showing no significant difference in using either method. GRA

N92-26113# Analytical Sciences Corp., Reading, MA.
CFLOS4D ACCURACY ASSESSMENT USING WHOLE SKY IMAGER DATA Final Technical Report, 1 Sep. 1988 - 30 Apr. 1991
Kenneth B. MacNichol and Steven R. Finch 18 Apr. 1991 73 p
(Contract F19628-88-C-0153; AF Proj. PE-62101F; AF Proj. P6670-T09-WUAR)
(PL-TR-91-2098) Avail: NTIS HC/MF A04

The CFLOS4D and CFARC simulation programs are based on several fundamental models of clouds and cloud cover effects. Validating these programs, therefore, require an approach which recognizes their inherent hierarchical nature. The hierarchical model validation is described along with associated analyses of the CFLOS4D program using data collected by the Whole Sky Imager (WSI) system. Specifically, the rigorous methodology used to compare WSI data derived results with simulator predictions is discussed along with the methodology to perform data requirements analyses which determine the quantity of WSI data needed to assess simulator utility within specified accuracy. Several studies are then discussed at the model component level, including models

governing the probability of a cloud free line of sight (CFLOS), CFLOS recurrence and persistence frequencies and sky cover temporal and spatial correlations. Author

N92-26133# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
FORECAST OF ATLANTIC SEASONAL HURRICANE ACTIVITY FOR 1992
William M. Gray 5 Jun. 1992 17 p Sponsored by NSF and NOAA
Avail: NTIS HC/MF A03

Details are presented of the forecast for the amount of tropical cyclone activity which might be expected to occur in the Atlantic Ocean region, including the Caribbean Sea and the Gulf of Mexico, during 1992. This forecast is based on ongoing research relating to the amount of seasonal Atlantic tropical cyclone activity that can be specified in early June by four factors: (1) the Quasi-Biennial Oscillation of equatorial stratospheric wind (QBO); (2) the El Nino (EN); (3) West African Rainfall (AR) anomalies of the previous year; and (4) West African west to east gradients of surface pressure and temperature during Feb. through May. Information received through 3 June 1992 indicates that the 1992 hurricane season should be below average with about 4 hurricanes, 8 named storms of at least tropical storm intensity; about 15 hurricane days, a total of 35 named storm days and a Hurricane Destruction Potential of 35. Reduced hurricane activity during the 1992 season will be due to Tropical Pacific Sea Surface Temperature anomaly patterns; below average rainfall conditions are expected in the Sahel region of West Africa; and West Africa west to east pressure and temperature gradients during Feb. to May indicate a weaker than normal summer monsoon trough and consequently, below average hurricane activity. Author

N92-26149# State Univ. of New York, Albany. Dept. of Atmospheric Science.
DIAGNOSTIC STUDIES OF EXPLOSIVE MARITIME CYCLOGENESIS Final Report
Daniel Keyser Jan. 1992 7 p
(Contract N00014-88-K-0074)
(AD-A245733) Avail: NTIS HC/MF A02

In selecting cases for study, it was proposed to give priority to those that were extensively documented and scrutinized by the synoptic community, allowing application of novel and unfamiliar diagnostic approaches on well understood cases. Specific issues to be pursued were: (1) determining whether conventional quasi-geostrophic dynamics can explain the rapid evolution of ERICA-type storms qualitatively or whether more general dynamics should be invoked; (2) quantifying the relative importance of dynamical, diabatic, and frictional processes in rapid development; and (3) establishing the extent to which rapid development is an exceptional response to ordinary forcing or an ordinary response to exceptional forcing. Following the initiation of the research project, it was decided to broaden the scope of the research, both to take advantage of unforeseen opportunities and to compensate for unanticipated delays, the latter involving the recruitment of highly qualified graduate students and the development of the appropriate diagnostic tools for performing the proposed research. A concise summary of each task completed is presented. GRA

N92-26151# Reading Univ. (England).
COORDINATION OF MESOSCALE METEOROLOGICAL RESEARCH BETWEEN ASL AND EUROPEAN GROUPS Interim Report No. 6, 1 Nov. 1991 - 31 Jan. 1992
R. P. Pearce 31 Jan. 1992 2 p
(Contract DAJA45-90-C-0009)
(AD-A245736; R/D-6323-EN-01) Avail: NTIS HC/MF A01

This is necessarily a brief report since there has been some delay in dispatched data tapes from ASL to the various participants in the Mesoscale Model Comparison Project, necessitating a revision of the arrangements for the preliminary analysis of the results. These arrangements were that participants should return their results on floppy disks to ASL by 15th January. These would then be analyzed by Mr. Meyers, Professor Pielke and myself at ASL during late January/early February and appropriate subsets of the results selected for the pre-workshop volume. In the event, although the Phase 1 data tapes were dispatched during August, the Phase 2 tapes were not dispatched to participants until mid-December. This was due to difficulties encountered by ASL with their contractors dealing with the validation of the WIND experiment field data tapes. Each participating group is now being contacted to ascertain whether it can carry out the integrations and submit the results to ASL by mid-March. If this proves possible, the analysis of the results will be carried out at ASL during late March/early April. Hopefully arrangements to hold the workshop during 16 to 18 June will remain unchanged. GRA

N92-25613*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
SATELLITE-DERIVED SURFACE LATENT HEAT FLUXES IN A RAPIDLY INTENSIFYING MARINE CYCLONE
Douglas K. Miller and Kristina B. Katsaros *In its* Microwave Radiometer Studies of Atmospheric Water Over the Oceans, Volume 1 Mar. 1992 p 1-40 (For primary document see N92-25612 16-43)
Avail: NTIS HC/MF A06

N92-25614*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
A COLD AIR OUTBREAK OVER THE NORWEGIAN SEA OBSERVED WITH THE TIROS-N OPERATIONAL VERTICAL SOUNDER (TOVS) AND THE SPECIAL SENSOR MICROWAVE/IMAGER (SSM/I)
Chantal Claud, Kristina B. Katsaros, Grant W. Petty, Alain Chedin, and Noelle A. Scott (Ecole Polytechnique, Palaiseau, France) *In its* Microwave Radiometer Studies of Atmospheric Water Over the Oceans, Volume 1 Mar. 1992 p 41-81 (For primary document see N92-25612 16-43)
Avail: NTIS HC/MF A06

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-25480# Scripps Institution of Oceanography, La Jolla, CA.
OCEANIC CO2 MEASUREMENTS FOR THE WOCE HYDROLOGICAL SURVEY IN THE PACIFIC OCEAN; SHIPBOARD ALKALINITY ANALYSES DURING 1991 AND 1992
C. D. Keeling 1992 3 p
(Contract DE-FG03-91ER-61116)
(DE92-007129; DOE/ER-61116/T1) Avail: NTIS HC/MF A01

The Department of Energy (DOE) Carbon Dioxide Science Team is contributing measurements of the carbon system in sea water on transects of the WOCE Hydrological Survey sponsored by the United States. This project is to provide measurements of titration alkalinity of sea water, an effort that is in addition to our collecting samples of sea water brought back to our shore laboratory and analyzed for dissolved inorganic carbon (DIC) and alkalinity. Our original proposal called for approximately 1200 analyses at sea in 1991 and 4400 in 1992. In preparation for measurements at sea, the project budget called for the construction of a dual potentiometric sea-going titration system. The titration system is of novel design in order to achieve at sea as close as possible the same high precision that we have previously achieved in the laboratory using gravimetric procedures. Two motor driven precision syringes dispense sea water volumetrically to two titration cells, each separately connected to a Dosimat acid dispenser. Each system is driven by a notebook computer that analyzes the full titration curve of sea water and calculates the alkalinity.

DOE

N92-25981*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
NASA WALLOPS FLIGHT FACILITY AIR-SEA INTERACTION RESEARCH FACILITY
Steven R. Long Jun. 1992 34 p
(NASA-RP-1277; Rept-92B00059; NAS 1.61:1277) Avail: NTIS HC/MF A03

This publication serves as an introduction to the Air-Sea Interaction Research Facility at NASA/GSFC/Wallops Flight Facility. The purpose of this publication is to provide background information on the research facility itself, including capabilities, available instrumentation, the types of experiments already done, ongoing experiments, and future plans. Author

N92-26146# Naval Postgraduate School, Monterey, CA.
NONLINEAR TRANSFORMATION OF DIRECTIONAL WAVE SPECTRA IN SHALLOW WATER Ph.D. Thesis
Manuel A. Abreu Sep. 1991 126 p
(AD-A245727) Avail: NTIS HC/MF A07

A shallow water, nonlinear spectral wave transformation model is developed for conditions of a mild sloping bottom (mu = Grad h/kh less than 1) and small amplitude effects (epsilon = eta/h less than 1). Nonlinearities and combined shoaling and refraction effects act on the same time and length scales. The evolution equation of the wave action is prescribed by the wave Boltzmann equation, whereby resonant collinear triad interactions transfer energy among Fourier components. Combined shoaling and refraction effects are taken into account through the geometrical optics approximation. A numerical solution of the three wave collision integral is developed, and the steady state wave Boltzmann equation is integrated using a piecewise ray method. The model is tested using the high resolution frequency directional wave spectrum of Freilich, Guza and Elgar (1990) that shows nonlinear transfers of energy between both harmonic and non-harmonic frequencies. A digitized version of the measured frequency-directional spectrum at 10 meter depth is evolved 246 meter shoreward over a bathymetry of straight and parallel bottom contours to 4 meter depth. The model predicts the prominent spectral features in the measured wave field. The model results are in general superior to estimates using linear, finite depth wave theory, and they compare well with the observations in the region of the spectrum dominated by nonlinear effects. GRA

N92-26147# Washington Univ., Seattle. Polar Science Center.
COORDINATED EASTERN ARCTIC RESEARCH EXPERIMENT (CEAREX) Final Report
Roger Colony 10 Jan. 1992 3 p
(Contract N00014-90-J-1249)
(AD-A245731) Avail: NTIS HC/MF A01

CEAREX consisted of three separate studies: oceanic heat flux at the ice-ocean interface, ice-draft topography, and the Ice Data Acquisition Project (IDAP). To estimate the oceanic heat flux at the ice-ocean interface, we monitored 12 sites on a single, multiyear sea-ice floe drifting in the Arctic Ocean northeast of Svalbard. At each site, we measured (1) the vertical temperature gradient through the sea ice to estimate the conductive heat flux at the ice-ocean interface, and (2) the change in ice thickness to estimate the heat flux associated with the melting and freezing at the ice-ocean interface. The oceanic heat flux was deduced as a residual of the total energy balance at the ice-ocean interface. An experiment on a multiyear ice floe in the eastern Arctic Ocean to study internal waves and other small-scale oceanographic features was undertaken because interpretation of some of the oceanographic measurements was expected to depend on the geometric configuration of the ice draft. The Ice Data Acquisition Program tested equipment for measuring temperatures and energy fluxes at the snow-ice and ice-ocean interfaces. A stochastic model of iceberg production, drift, and grounding was developed to estimate probability density functions for the number of icebergs likely to be found in a prescribed geographical region. GRA

51 LIFE SCIENCES (GENERAL)

N92-25423# State Univ. of New York, Stony Brook.
X RAY MICROIMAGING BY DIFFRACTIVE TECHNIQUES
1991 40 p
(Contract DE-FG02-89ER-60858)
(DE92-005530; DOE/ER-60858/2) Avail: NTIS HC/MF A03

Progress is reported on high resolution x-ray techniques that were developed to image wet biological specimens. The minimization of radiation damage to the specimens and holographic imaging are described. DOE

N92-26160# National Inst. of General Medical Sciences, Bethesda, MD.
STRUCTURES OF LIFE: DISCOVERING THE MOLECULAR SHAPES THAT DETERMINE HEALTH OR DISEASE, JULY 1991
M. Pines Jul. 1991 73 p
(PB92-147834; NIH/PUB-91/2778) Avail: NTIS HC/MF A04

The report discusses research in the molecular shapes of DNA that cause human disease or contribute to human health. Topics include the following areas: the search for key biological shapes; the reason why proteins fold; recognizing protein structures; deciphering the structure of membrane proteins; the way in which proteins turn genes on or off; and seeking a cure for the common cold. Other discussions cover drug design and the use of new technology in speeding research on DNA structures. A glossary is included. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-25304# Technische Univ., Delft (Netherlands).
IN-VIVO PROTON MAGNETIC RESONANCE SPECTROSCOPY: EVALUATION OF MULTIPLE QUANTUM TECHNIQUES FOR SPECTRAL EDITING AND A TIME DOMAIN FITTING PROCEDURE FOR QUANTIFICATION Ph.D. Thesis
Johannes Edwinus vanDijk 1991 154 p
(ETN-92-91283) Avail: NTIS HC/MF A08

Several aspects concerning the use of multiple quantum coherence techniques for in vivo studies are detailed. It is shown that a zero quantum sequence can be used to selectively measure lactate and that this sequence can be combined with a localization technique. Editing techniques to separate signals from two complex spin systems (glutamate and glutamine) are described. Since it appeared to be very difficult to selectively measure one of these systems and suppress the other with multiple quantum coherence techniques, an alternative method is also given. Pathophysiological mechanisms responsible for the induction of hepatic encephalography are studied. A study in which an editing sequence is used to detect lactate, and a nonediting sequence is used to measure the complete spectrum is performed. Data processing techniques are addressed. The incorporation of knowledge in a Gauss-Newton iterative fitting procedure is described and it is shown how actual prior knowledge can be obtained and used to analyze a signal consisting of damped sinusoids which in the frequency domain severly overlap. The method is used to fit, frequency selectively, real in vivo signals. ESA

N92-25422# Colorado Univ., Boulder. Dept. of Pharmacology.
THE cDNA EXPRESSION MAP OF THE HUMAN GENOME: METHODS DEVELOPMENT AND APPLICATIONS USING BRAIN cDNAs
J. M. Sikela 1991 4 p
(Contract DE-FG02-91ER-61241)
(DE92-005520; DOE/ER-61241/1) Avail: NTIS HC/MF A01

The following describes the progress on human brain cDNA sequencing and mapping that our laboratory has made over the past few months. It should be noted that our first funding installment for the first phase of this grant was obtained approximately two

weeks ago. Therefore, the progress that is described represents efforts that were carried out without DOE Genome funds and thus largely are a continuation of pilot studies we began last year. We anticipate, now that DOE funds have arrived, that we will be able to significantly scale up our efforts and productivity. DOE

N92-25435# National Inst. for Occupational Safety and Health, Cincinnati, OH.
PROCEEDINGS OF THE SCIENTIFIC WORKSHOP ON THE HEALTH EFFECTS OF ELECTRIC AND MAGNETIC FIELDS ON WORKERS
P. J. Bierbaum and J. M. Peters 30 Jan. 1991 233 p Workshop held in Cincinnati, OH, 30-31 Jan. 1991
(PB92-131721; DHHS/PUB/NIOSH-91-111) Avail: NTIS HC/MF A11

Participants in the workshop discussed various aspects of the health effects on workers exposed to electric and magnetic fields. Specific topics discussed included low frequency electromagnetic fields, biological effects of extremely low frequency electromagnetic fields, health effects of exposures, occupational exposure assessment for electric and magnetic fields in the 10 to 1000 hertz frequency range, and magnetic field management. Research recommendations from workshop panels concerning in-vitro/cellular mechanism studies, exposure assessments, and methods for reducing exposures were provided. Author

N92-25481# Brookhaven National Lab., Upton, NY.
MONOCHROMATIC COMPUTED TOMOGRAPHY OF THE HUMAN BRAIN USING SYNCHROTRON X RAYS: TECHNICAL FEASIBILITY
E. Nachaliel, F. A. Dilmanian, R. F. Garrett, W. C. Thomlinson, L. D. Chapman, N. F. Gmuer, N. M. Lazarz, H. R. Moulin, M. L. Rivers, and H. Rarback et al 1991 25 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-007143; BNL-47068; CONF-9110146-7) Avail: NTIS HC/MF A03

A monochromatic computed tomography (CT) scanner is being developed at the X17 superconducting wiggler beamline at the National Synchrotron Light Source (NSLS), Brookhaven National Laboratory, to image the human head and neck. The system configuration is one of a horizontal fan beam and an upright seated rotating subject. The purpose of the project is to demonstrate improvement in the image contrast and in the image quantitative accuracy that can be obtained in monochromatic CT and to apply the system to specific clinical research programs in neuroradiology. This paper describes the first phantom studies carried out with a prototype system, using the dual photon absorptiometry (DPA) method at energies of 20 and 39 KeV. The results show that improvements in image contrast and quantitative accuracy are possible with monochromatic DPA CT. Estimates of the clinical performance of the planned CT system are made on the basis of these initial results. DOE

N92-25508# Oak Ridge National Lab., TN.
RADIATION EFFECTS IN SPACE: RESEARCH NEEDS
R. J. M. Fry 1991 5 p Presented at the 9th International Congress of Radiation Research (ICRR) Conference, Toronto, Ontario, 7-12 Jul. 1991
(Contract DE-AC05-84OR-21400)
(DE92-006597; CONF-9107136-9) Avail: NTIS HC/MF A01

At the 8th International Congress of Radiation Research an account was given of the findings of the National Council on Radiation Protection and Measurements (NCRP) on radiation environments in space and their estimates of dose equivalents. The committee gave guidance about possible career limits of exposure to radiation during low earth orbits based on risk estimates available at the time. The information about deep space was insufficient to estimate the risks for missions into deep space. It was known that new risk estimates and recommendations of dose limits for terrestrial workers were on the way, and they are now available. The NCRP has started to reassess the radiation risks in space. The gaps in the information about salient aspects of the effects of the space radiation required for predicting the radiation risks, especially for deep space missions, are apparent and are the subject of this paper. DOE

N92-25743# Adelaide Children's Hospital, North Adelaide (Australia)
CORRELATION OF PHYSICAL AND GENETIC MAPS OF HUMAN CHROMOSOME 16
G. R. Sutherland 1991 8 p
(Contract DE-FG02-89ER-60863)
(DE92-007547; DOE/ER-60863/3) Avail: NTIS HC/MF A02

This project aimed to divide chromosome 16 into approximately 50 intervals of approx. 2Mb in size by constructing a series of mouse/human somatic cell hybrids each containing a rearranged chromosome 16. Using these hybrids, DNA probes would be regionally mapped by Southern blot or PCR analysis. Preference would be given to mapping probes which demonstrated polymorphisms for which the CEPH panel of families had been typed. This would allow a correlation of the physical and linkage maps of this chromosome. The aims have been substantially achieved. Some 49 somatic cell hybrids have been constructed which have allowed definition of 46, and potentially 57, different physical intervals on the chromosome. Some 164 loci have been fully mapped into these intervals. A correlation of the physical and genetic maps of the chromosome is in an advanced stage of preparation. The somatic cell hybrids constructed have been widely distributed to groups working on chromosome 16 and other genome projects. DOE

N92-25989# Brookhaven National Lab., Upton, NY.
A SURVEY OF MEDICAL DIAGNOSTIC IMAGING TECHNOLOGIES
V. Heese, N. Gmuer, and W. Thomlinson Oct. 1991 86 p
(Contract DE-AC02-76CH-00016)
(DE92-007633; BNL-46739) Avail: NTIS HC/MF A05

The fields of medical imaging and medical imaging instrumentation are increasingly important. The state-of-the-art continues to advance at a very rapid pace. In fact, various medical imaging modalities are under development at the National Synchrotron Light Source (such as MECT and Transvenous Angiography.) It is important to understand how these techniques compare with today's more conventional imaging modalities. The purpose of this report is to provide some basic information about the various medical imaging technologies currently in use and their potential developments as a basis for this comparison. This report is by no means an in-depth study of the physics and instrumentation of the various imaging modalities; instead, it is an attempt to provide an explanation of the physical bases of these techniques and their principal clinical and research capabilities. DOE

N92-25993# Los Alamos National Lab., NM.
LASER-INDUCED CONTAINED-VAPORIZATION IN TISSUE
R. S. Dingus 1992 9 p Presented at the Society of Photo-Optical Instrumentation Engineers International Symposium on Laser Spectroscopy as part of SPIE's Symposium on Optics, Electro-Optics and Laser Applications in Science and Engrg., Los Angeles, CA, 19-24 Jan. 1992
(Contract W-7405-eng-36)
(DE92-008446; LA-UR-92-363; CONF-920124-11) Avail: NTIS HC/MF A02

When a transparent liquid or solid medium is present in front of an opaque target being irradiated by an intense laser beam, then the expansion of hot vapors generated (at the interface between the medium and the target) by the irradiant heating of the target is restrained by the medium. The tamping effect of the overlying liquid or solid can cause a much larger fraction of the deposited energy to go into kinetic energy, which leads to enhanced tissue disruption, compared to when a gas or vacuum is in front of the target. Condensable vapors and high thermal conductivity in the surrounding material facilitate rapid energy transport out of the vapor, which can cause a major reduction in the tamping

enhancements. This contained-vaporization process is likely important in laser-medical applications such as, for example, laser angioplasty and laser lithotripsy. The work enhancement by the process is probably advantageous for lithotripsy in providing the necessary energy to break urinary stones; however, for angioplasty, the enhancement may provide little aid in removing plaque but may cause significant damage to arterial walls. If gas could be introduced into the artery proceeding irradiation of the plaque, then the enhancements could be avoided. In summary, careful management of the tamping conditions during tissue irradiations in the clinical applications of lasers should lead to significant improvements in the overall desired outcome. DOE

N92-26030*# Brown Univ., Providence, RI. Dept. of Pathology
MECHANICAL STIMULATION OF SKELETAL MUSCLE GENERATES LIPID-RELATED SECOND MESSENGERS BY PHOSPHOLIPASE ACTIVATION
Herman H. Vandenburgh, Janet Shansky, Patricia Karlisch, and Rosa Lopez Solerssi 1991 50 p Prepared in cooperation with Miriam Hospital, Providence, RI
(Grants NAG2-414; NIH-AR-39998)
(NASA-CR-190158; NAS 1.26:190158) Avail: NTIS HC/MF A03

Repetitive mechanical stimulation of cultured avian skeletal muscle increases the synthesis of prostaglandins E2 and F2(alpha) which regulate protein turnover rates and muscle cell growth. Mechnical stimulation significantly increases the breakdown rate of (3)H-arachidonic acid labelled phospholipids, releasing free (3)H-arachidonic acid, and the rate-limiting precursor of prostaglandin synthesis. Mechanical stimulation also significantly increases (3)H-arachidonic acid labelled diacylglycerol formation and intracellular levels of inositol phosphates from myo-2-(3)H inositol labelled phospholipids. Phospholipase A2, phosphatidylinositol-specific phospholipase C (PLC), and phospholipase D (PLD) are activated by stretch. The lipase inhibitors bromophenacylbromide and RHC80267 together reduce stretch-induced prostaglandin production by 73-83 percent. The stretch-induced increases in prostaglandin production, (3)H-arachidonic acid labelled phospholipid breakdown, and (3)H-arachidonic acid labelled diacylglycerol formation occur independently of cellular electrical activity (tetrodotoxin insensitive) whereas the formation of inositol phosphates from myo-2-(3)H inositol labelled phospholipids are dependent on cellular electrical activity. These results indicate that mechanical stimulation increases the lipid-related second messengers arachidonic acid, diacylglycerol, and prostaglandins through activation of specific phospholipases such as PLA2 and PLD, but not by activation of phosphatidylinositol-specific PLC. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N92-25732*# Georgia Inst. of Tech., Atlanta.
REQUIREMENTS FOR PSYCHOLOGICAL MODELS TO SUPPORT DESIGN: TOWARDS ECOLOGICAL TASK ANALYSIS
Alex Kirlik 1991 43 p
(Grant NAG2-656)
(NASA-CR-190334; NAS 1.26:190334) Avail: NTIS HC/MF A03

Cognitive engineering is largely concerned with creating environmental designs to support skillful and effective human activity. A set of necessary conditions are proposed for psychological models capable of supporting this enterprise. An analysis of the psychological nature of the design product is used to identify a set of constraints that models must meet if they can usefully guide design. It is concluded that cognitive engineering requires models with resources for describing the integrated human-environment system, and that these models must be capable of describing the activities underlying fluent and effective interaction. These features are required in order to be able to predict the cognitive activity that will be required given various design concepts, and to design systems that promote the acquisition of fluent, skilled behavior. These necessary conditions suggest that an ecological approach can provide valuable resources for psychological modeling to support design. Relying heavily on concepts from Brunswik's and Gibson's ecological theories, ecological task analysis is proposed as a framework in which to predict the types of cognitive activity required to achieve productive behavior, and to suggest how interfaces can be manipulated to alleviate certain types of cognitive demands. The framework is described in terms, and illustrated with an example from the previous research on modeling skilled human-environment interaction. Author

N92-26023# Naval Postgraduate School, Monterey, CA.
FINITE MEMORY MODEL FOR HAPTIC RECOGNITION M.S. Thesis
Philip G. Beierl Dec. 1991 81 p
(AD-A245342) Avail: NTIS HC/MF A05

This study attempts to model the process by which humans identify remote objects using a force reflecting telemanipulator in order to apply this understanding to future ROV designs employing the concept of telepresence. A theoretical model is proposed in which object identification is primarily independent upon feature identification and capacity to remember the sequence of features. A computer simulation of this model is constructed and used to produce theoretical object identification performance which can be compared to actual human performance. The capacity of short term memory of a sequence of features is also studied in a laboratory using a telemanipulator. GRA

N92-25372# National Space Development Agency, Tokyo (Japan). Space Station Program Dept.
PAYLOAD CREW TRAINING IN FUWATTO 1992 (FIRST MATERIAL PROCESSING TEST) PROJECT
Mamoru Mouri and Shigeki Kamigaichi *In its* Preprints of NASDA's 6th Technical Symposium 5 Jun. 1991 p 1-22 In JAPANESE; ENGLISH summary (For primary document see N92-25371 16-16)
Avail: NTIS HC/MF A06

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-25161*# Idaho Univ., Moscow.
EXERCISE/RECREATION FACILITY FOR A LUNAR OR MARS ANALOG Final Report
Jun. 1991 40 p
(Contract NASw-4435)
(NASA-CR-189993; NAS 1.26:189993) Avail: NTIS HC/MF A03

Discussed here is a project to design an exercise/recreation station for an earth based simulator of a lunar or Martian habitat. Specifically, researchers designed a stationary bicycle that will help people keep fit and prevent muscular atrophy while stationed in space. To help with motivation and provide an element of recreation during the workout, the bicycle is enhanced by a virtual reality system. The system will simulate various riding situations and the choice of mountain bike or road bike. The bike employs a magnetic brake that provides continuously changing tension to simulate actual riding conditions. This braking system will be interfaced directly with the virtual reality system. Also integrated into the virtual reality system will be a monitoring system that regulates heart rate, work rate, and other functions during the course of the session. Author

N92-25961*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NUTRITIONAL REQUIREMENTS FOR SPACE STATION FREEDOM CREWS
Helen W. Lane, Barbara L. Rice, and Christine F. Wogan, ed. (Krug Life Sciences, Inc., Houston, TX.) Washington Jun. 1992 15 p Panel held in Houston, TX, 4-5 Feb. 1991
(NASA-CP-3146; S-672; NAS 1.55:3146) Avail: NTIS HC/MF A03

The purpose of this report was to set preliminary nutritional requirements for crewmembers flying from 90 to 180 day missions on Space Station Freedom. Specific recommendations included providing crewmembers with in flight feedback on nutritional intake, weight and strength, and incorporating issues of energy intake, body weight, body composition, strength, and protein intake in the flight medicine program. Exercise must be considered an integral part of any plan to maintain nutritional status, especially those modes that stress the skeleton and maintain body weight. Nutrient intake, amount of exercise, and drugs ingested must be recorded daily; high priority should be given to development of fully automated record systems that minimize astronauts' effort. A system of nutritional supplements should be developed to provide a method for reducing intake deficits that become apparent. Finally, post flight monitoring should include bone density, muscle mass and function, and iron status at three and six months after landing. Author

N92-26025# Brookhaven National Lab., Upton, NY.
COMPUTER-BASED DIAGNOSTIC MONITORING TO ENHANCE THE HUMAN-MACHINE INTERFACE OF COMPLEX PROCESSES
I. S. Kim Feb. 1992 14 p Presented at the 8th Power Plant Dynamics, Control and Testing Symposium, Knoxville, TN, 27-29 May 1992
(Contract DE-AC02-76CH-00016)
(DE92-011545; BNL-47229; CONF-920538-12) Avail: NTIS HC/MF A03

There is a growing interest in introducing an automated, on-line, diagnostic monitoring function into the human-machine interfaces (HMI's) or control rooms of complex process plants. The design of such a system should be properly integrated with other HMI systems in the control room, such as the alarms system or the Safety Parameter Display System (SPDS). A conceptual foundation for the development of a Plant-wide Diagnostic Monitoring System (PDMS) is presented along with functional requirements for the system and other advanced HMI systems. Insights are presented into the design of an efficient and robust PDMS, which were gained from a critical review of various methodologies developed in the nuclear power industry, the chemical process industry, and the space technological community. DOE

N92-26158# Naval Training Systems Center, Orlando, FL.
NIGHT VISION GOGGLE SIMULATION Final Technical Report, 1988-1990
Richard C. Hebb Oct. 1991 20 p
(AD-A245745; NAVTRASYSCEN-TR-92-001) Avail: NTIS HC/MF A03

The use of Night Vision Goggles (NVGs) has increased dramatically and so has the number of accidents attributed to NVG aided flight. The work performed under this project represents an investigation of the use of Night Vision Goggles and the exploration of a method for providing simulation of night vision imagery in an interactive flight simulator environment. The characteristics of the Aviators Night Vision (ANVIS) Goggles were investigated and are summarized. A helmet mounted display concept was developed and a testbed was developed. A commercially available magnetic tracking device was obtained to provide head tracking, and, through a in-house designed interface, was interfaced to a SEL flight computer and various image generators. A Z-transform based predictive algorithm for compensating for the throughput delay image effects of a head tracker, flight computer, and image generator was developed and also integrated into the testbed for evaluation. The helmet display NVG concept represents a good alternative to full up flight simulators of the Weapons Tactics Trainers (WTT) type, and could provide significant enhancements to classroom and on the job training. A part task trainer could be developed using the helmet mounted NVG concept that would bridge the gap between classroom and flight. GRA

N92-25838# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
EUROPEAN ECLSS TECHNOLOGY DEVELOPMENT RESULTS AND FURTHER ACTIVITIES
H. Funke, H. Preiss, S. Klingele, and G. Tan (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 103-111 Sponsored in part by ESA/ESTEC and DLR/BMFT (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25839# Hamilton Standard, Windsor Locks, CT.
ADVANCED REGENERATIVE LIFE SUPPORT FOR SPACE EXPLORATION
H. T. Couch, J. W. Auman, Jr., and T. C. Falvey *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 113-120 (For primary document see N92-25828 16-18)
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N92-25840# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
ENGINEERING PROBLEMS OF INTEGRATED REGENERATIVE LIFE-SUPPORT SYSTEMS
N. M. Samsonov, N. S. Farafonov, O. P. Jakimenko, E. I. Grigorov, V. N. Kubasov, E. N. Zaitsev, I. V. Lavrov, and B. A. Adamovich (Institute of Biomedical Problems, Moscow, USSR) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 121-122 (For primary document see N92-25828 16-18)
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N92-25841# Alenia Spazio S.p.A., Turin (Italy).
A COMBINED CABIN/AVIONICS AIR LOOP DESIGN FOR THE SPACE STATION LOGISTIC MODULE
Renato DAuria and Tiziano Malosti *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 123-127 (For primary document see N92-25828 16-18)
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N92-25842# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ESA STANDARDISATION PROCESS THROUGH THE EXAMPLE OF MANNED SPACECRAFT ATMOSPHERES
C. Soulez-Lariviere and J. C. LePechon (JCLP Hyperbarie, Paris, France) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 129-131 (For primary document see N92-25828 16-18)
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N92-25843# Nelson Space Services Ltd., London (England).
ESA PSS-03-406: LIFE SUPPORT AND HABITABILITY MANUAL
R. C. Huttenbach and R. A. Binot (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 133-144 (For primary document see N92-25828 16-18)

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N92-25862# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
TRACE GAS CONTAMINATION MANAGEMENT IN THE COLUMBUS MTFF
H. Abele and R. R. Lawson (Bowman Ltd., Bristol, England) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 287-294 (For primary document see N92-25828 16-18)
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N92-25863# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space System and Project Dept.
AN INNOVATIVE TECHNOLOGY FOR DETECTING AND MONITORING TRACE-GAS CONTAMINATION OF THE COLUMBUS FREE FLYER ATMOSPHERE
R. Stanyon and D. Zanotti *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 295-300 (For primary document see N92-25828 16-18)
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N92-25864# Bruker-Franzen Analytik G.m.b.H., Bremen (Germany, F.R.).
A GAS CHROMATOGRAPHIC SEPARATOR FOR COLUMBUS TRACE GAS CONTAMINATION MONITORING ASSEMBLY
J. Franzen, G. Baykut, H.-P. Vetters, G. Weiss, and H. Abele (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 301-305 (For primary document see N92-25828 16-18)
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N92-25865# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SELECTION OF AN OPTIMISED HIGH TEMPERATURE CATALYST FOR ATMOSPHERE TRACE CONTAMINANT CONTROL
J. Witt, D. deChambure, and K. Ammann (Draegerwerk A.G., Luebeck, Germany, F.R.) *In its* 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 307-311 (For primary document see N92-25828 16-18)
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N92-25866# Draegerwerk A.G., Luebeck (Germany, F.R.).
INVESTIGATION OF CATALYSTS FOR THE REMOVAL OF CARBON MONOXIDE AND HYDROGEN FROM AIR
K. Ammann, H. Heyer, S. Haupt, and A. Exner (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 313-316 (For primary document see N92-25828 16-18)
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N92-25867# Draegerwerk A.G., Luebeck (Germany, F.R.).
BREADBOARDING OF THE MAIN CHARCOAL FILTER: A COMPONENT OF THE TRACE GAS CONTAMINATION CONTROL ASSEMBLY FOR THE MTFF
H. Heyer, H. Abele, K. Ammann, and R. Lawson (Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 317-322 (For primary document see N92-25828 16-18)
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N92-25868# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
TRACE GAS MONITORING STRATEGIES FOR MANNED SPACE MISSIONS
S. Klingele and G. Tan (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 323-328 (For primary document see N92-25828 16-18)
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N92-25887# Oesterreichische Raumfahrt- und Systemtechnik, Vienna (Austria).
CARBON DIOXIDE REDUCTION SYSTEM AS PART OF AN AIR REVITALIZATION SYSTEM
K. Sperker and G. Tan (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 469-472 (For primary document see N92-25828 16-18)
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N92-25888# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
CARBON DIOXIDE REDUCTION ABOARD THE SPACE STATION
L. I. Gavrilov, V. A. Naumov, A. I. Rjabkin (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR), T. N. Pavlova, N. M. Samsonov, and N. S. Farafonov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 473-475 (For primary document see N92-25828 16-18)
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N92-25889# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
A SYSTEM FOR OXYGEN GENERATION FROM WATER ELECTROLYSIS ABOARD THE MANNED SPACE STATION MIR
J. E. Belaventsev, L. I. Gavrilov, A. S. Guzenberg, N. S. Gushin, V. P. Korolev, A. G. Pshenichnikov, A. M. Rjabkin (Academy of Sciences, USSR, Moscow), N. M. Samsonov, and N. S. Farafonov *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 477-479 (For primary document see N92-25828 16-18)
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N92-25890# AiResearch Mfg. Co., Torrance, CA.
DEVELOPMENT OF A SABATIER CARBON DIOXIDE REDUCTION SYSTEM FOR SPACE APPLICATION
Hal J. Strumpf and C. Y. Chin *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 481-487 (For primary document see N92-25828 16-18)
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N92-25891# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).
AIR REGENERATION FROM MICROCONTAMINANTS ABOARD THE ORBITAL SPACE STATION
N. M. Samsonov, L. K. Abramov, L. E. Litvinov, V. I. Margulis, A. S. Guzenberg, and A. M. Rjabkin (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 489-491 (For primary document see N92-25828 16-18)
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N92-25892# CJB Developments Ltd., Portsmouth (England).
AIR PURIFICATION SYSTEMS FOR SUBMARINES AND THEIR RELEVANCE TO SPACECRAFT
R. A. J. Dams, C. J. Leppard, and T. W. Martin *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 493-497 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25893*# Applied Sciences Consultants, Inc., San Jose, CA.
MATHEMATICAL MODELING OF CONTROL SUBSYSTEMS FOR CELSS: APPLICATION TO DIET
Ahmad Waleh, Thoi K. Nguyen, and Valery Kanevsky *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 501-505 (For primary document see N92-25828 16-18)
(Contract NAS2-13260)
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N92-25894# Empresarios Agrupados, Madrid (Spain).
ECOSIM: AN ENVIRONMENTAL CONTROL SIMULATION SOFTWARE
R. Perez, V. Torroglosa, A. Lebru, and M. Novara (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 507-513 (For primary document see N92-25828 16-18)
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N92-25895# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
TRACE GAS CONTAMINATION CONTROL (TGCC) ANALYSIS SOFTWARE FOR COLUMBUS
H. P. Hafkemeyer *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 515-520 (For primary document see N92-25828 16-18)
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N92-25896# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
SIMTAS: THERMO- AND FLUIDDYNAMIC SIMULATION OF COMPLEX SYSTEMS
Ralf Simon and Jens Eickhoff *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 521-527 (For primary document see N92-25828 16-18)
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N92-25899*# Boeing Aerospace Co., Huntsville, AL. Missile and Space Div.
G189A MODELLING OF SPACE STATION FREEDOM'S ECLSS
Robert S. Barker and Roger vonJouanne *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 541-550 (For primary document see N92-25828 16-18)
(Contract NAS8-50000)
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55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N92-26044*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
CUMULATIVE REPORTS AND PUBLICATIONS THROUGH DECEMBER 31, 1991 Final Report
Feb. 1992 84 p
(Contracts NAS1-18605; NAS1-18107; NAS1-17070; NAS1-17130; NAS1-15810; NAS1-16394; NAS1-14101; NAS1-14472)
(NASA-CR-189608; NAS 1.26:189608) Avail: NTIS HC/MF A05
A reports and publications list is given from the Institute for Computer Applications in Science and Engineering (ICASE) through December 31, 1991. The major categories of the current ICASE research program are; numerical methods, control and parameter identification problems, computational problems in engineering and the physical sciences, and computer systems and software. Since ICASE reports are intended to be preprints of articles that will appear in journals or conference proceedings, the published reference is included when available. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-25254*# Research Inst. for Computing and Information Systems, Houston, TX.
EXPERT SYSTEM VERIFICATION AND VALIDATION STUDY: ES V/V WORKSHOP Interim Technical Report
Scott French and David Hamilton (International Business Machines Corp., Armonk, NY.) Mar. 1992 504 p
(Contract NCC9-16; RICIS Proj. AI-16)
(NASA-CR-190271; NAS 1.26:190271) Avail: NTIS HC/MF A22
The primary purpose of this document is to build a foundation for applying principles of verification and validation (V&V) of expert systems. To achieve this, some V&V as applied to conventionally implemented software is required. Part one will discuss the background of V&V from the perspective of (1) what is V&V of software and (2) V&V's role in developing software. Part one will also overview some common analysis techniques that are applied when performing V&V of software. All of these materials will be presented based on the assumption that the reader has little or no background in V&V or in developing procedural software. The primary purpose of part two is to explain the major techniques that have been developed for V&V of expert systems. H.A.

N92-25327# Westinghouse Savannah River Co., Aiken, SC.
IMPLEMENTING A COMPUTING ARCHITECTURE WITH WISDOM
J. R. Zebrowski 1991 7 p Presented at the DOE Mini Microcomputer Information Interchange, Pleasanton, CA, 23-25 Apr. 1991
(Contract DE-AC09-89SR-18035)
(DE92-009417; WSRC-MS-91-153; CONF-9104347-1) Avail: NTIS HC/MF A02

Over the past two years, the Savannah River Site (SRS) work force has expanded by more than 6000 employees. This large influx of personnel, in conjunction with the limited office space, has resulted in an overcrowding problem on site. To alleviate some of the overcrowding, Westinghouse Savannah River Company (WSRC) has been in the process of leasing space from several office buildings within Aiken, SC. Brookhaven, the latest off-site office building to be leased, is the starting point for a new direction in office automation which will eventually spread throughout SRS. The computing architecture in place at Brookhaven was designed to adhere to the SRS computer architecture guidelines as published by the WSRC Computer Architecture Standards Team (CAST). At the heart of the Brookhaven implementation is a Workstation Integration System for DOS, OS/2, and Macintosh (WISDOM). The key features of the WISDOM system include: it's utilization of a Local Area Network (LAN), it's Graphical User Interface (GUI), it's cross-platform capability, it's portable user interface, and the installation program. An overview of the network architecture is given, and WISDOM is discussed in detail. Some platform integration problems that need to be addressed are mentioned, and a summary of the user benefits that WISDOM provides is presented. DOE

N92-25370*# Research Inst. for Computing and Information Systems, Houston, TX.

FRAMEWORK PROGRAMMABLE PLATFORM FOR THE ADVANCED SOFTWARE DEVELOPMENT WORKSTATION (FPP/ASDW). DEMONSTRATION FRAMEWORK DOCUMENT. VOLUME 1: CONCEPTS AND ACTIVITY DESCRIPTIONS

Richard J. Mayer, Thomas M. Blinn, Paul S. deWitte, John W. Crump, and Keith A. Ackley (Knowledge Based Systems, Inc. College Station, TX.) 16 Apr. 1992 127 p

(Contract NCC9-16; RICIS Proj. SE-37)

(NASA-CR-190274; NAS 1.26:190274) Avail: NTIS HC/MF A07

The Framework Programmable Software Development Platform (FPP) is a project aimed at effectively combining tool and data integration mechanisms with a model of the software development process to provide an intelligent integrated software development environment. Guided by the model, this system development framework will take advantage of an integrated operating environment to automate effectively the management of the software development process so that costly mistakes during the development phase can be eliminated. The Advanced Software Development Workstation (ASDW) program is conducting research into development of advanced technologies for Computer Aided Software Engineering (CASE). Author

N92-25433*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CRAY MINI MANUAL

Geoffrey M. Tennille, Lona M. Howser, Andrea L. Overman, Judith A. Utley, Brenda A. Austin, and Theresa M. Flynn (Unisys Corp., Hampton, VA.) Apr. 1992 73 p Revised

(NASA-TM-107599; CSCC-CR-1c-Rev; NAS 1.15:107599) Avail: NTIS HC/MF A04

This document briefly describes the use of the CRAY supercomputers that are an integral part of the Supercomputing Network Subsystem of the Central Scientific Computing Complex at LaRC. Features of the CRAY supercomputers are covered, including: FORTRAN, C, PASCAL, architectures of the CRAY-2 and CRAY Y-MP, the CRAY UNICOS environment, batch job submittal, debugging, performance analysis, parallel processing, utilities unique to CRAY, and documentation. The document is intended for all CRAY users as a ready reference to frequently ask questions and to more detailed information contained in the vendor manuals. It is appropriate for both the novice and the experienced user. Author

N92-25440# Westinghouse Savannah River Co., Aiken, SC.

WISDOM: A PROTOTYPE OFFICE IMPLEMENTATION OF THE SRS COMPUTING ARCHITECTURE

D. W. Eckert 1991 11 p Presented at the Westinghouse Computer Symposium, Monroeville, PA, 21-22 Oct. 1991

(Contract DE-AC09-89SR-18035)

(DE92-009943; WSRC-MS-91-391; CONF-9110344-4) Avail: NTIS HC/MF A03

The Savannah River Site has historically allowed the purchase of IBM MS-DOS and Apple Macintosh computers based on user request. As workgroup file services are implemented on the Local Area Network, users desire to share data to a greater extent. This has resulted in mixed groups who now wish to share data files cleanly among dissimilar operating systems. WISDOM was designed as a system of network services, workstation platform standards, installation procedures, and application choices which would address data integration from the user perspective. Novell Netware provides a basis for file transfer, while Microsoft Windows supplies the GUI necessary to compliment the Macintosh. Central administration, networking protocols, host connectivity, and memory management restrictions required imaginative solutions. This paper describes the current status of the 500-workstation prototype; user acceptance and training; and outstanding issues to be addressed. Details are given on the design philosophy, some of the technology utilized, the implementation process, and future directions. DOE

N92-25523# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.

COMPUTER SCIENCE AT THE UNIVERSITY OF HELSINKI, 1991

M. Tienari and J. Tarhio Nov. 1991 75 p

(PB92-151539; A-1991-6; ISBN-951-45-5975-4) Avail: NTIS HC/MF A04

Activities at the Dept. of Computer Science are presented. The research projects are described and the members of the faculty are introduced. Recent publications of the faculty are listed according to their classification. The educational program is described, and course descriptions, the titles of recent theses, and the abstracts of recent Ph.D. theses are given. Author

N92-25644# Lawrence Livermore National Lab., CA.

WHAT DO YOU DO WHEN THE NETWORK IS 1 TO 2 ORDERS OF MAGNITUDE FASTER THAN THE BACKPLANE BUS?

Seth Abrahams Aug. 1991 7 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991

(Contract W-7405-eng-48)

(DE92-009523; UCRL-JC-103573-Rev-1;

CONF-9109230-13-Rev-1) Avail: NTIS HC/MF A02

The prototype High Performance Switching System will connect several different types of machines with widely varying clock and internal bus speeds. At one range we have a Cray YMP and a CRAY XMP with a High Performance Parallel Interface (HIPPI). At the other end there are many SUN 3/260 VME bus machines. In between, there are various flavors of MAC IIs. This presents a substantial speed matching problem. The CRAY HIPPI channel speed is 100 MB/s. The SUN VME bus speed is approximately 1 megabyte per second with bursts to 13 megabytes, the MAC II NU-BUS obtains about the same speed. The answer to what to do when the network is 2 to 3 orders of magnitude faster than the internal bus is to use big packets and even bigger buffers. This paper expands on that theme and describes the approach LLNL and Ancor Communications took in the case of the SUN VMEbus machine. DOE

N92-26110*# Lockheed Engineering and Sciences Co., Houston, TX.

PAYLOAD AND GENERAL SUPPORT COMPUTER (PGSC) DETAILED TEST OBJECTIVE (DTO) NUMBER 795 POSTFLIGHT REPORT: STS-41 Final Report

Jurine A. Adolf, Benjamin J. Beberness, and Kritina L. Holden 25 Oct. 1991 28 p Original contains color illustrations

(Contract NAS9-17900)

(NASA-CR-185678; JSC-25459; NAS 1.26:185678; LESC-29081)

Avail: NTIS HC/MF A03; 5 functional color pages

Since 1983, the Space Transportation System (STS) had routinely flown the GRiD 1139 (80286) laptop computer as a portable onboard computing resource. In the spring of 1988, the

GRiD 1530, an 80386 based machine, was chosen to replace the GRiD 1139. Human factors ground evaluations and detailed test objectives (DTO) examined the usability of the available display types under different lighting conditions and various angle deviations. All proved unsuitable due to either flight qualification of usability problems. In 1990, an Electroluminescent (EL) display for the GRiD 1530 became flight qualified and another DTO was undertaken to examine this display on-orbit. Under conditions of indirect sunlight and low ambient light, the readability of the text and graphics was only limited by the observer's distance from the display. Although a problem of direct sunlight viewing still existed, there were no problems with large angular deviations nor dark adaptation. No further evaluations were deemed necessary. The GRiD 1530 with the EL display was accepted by the STS program as the new standard for the PGSC. Author

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-25171# Fermi National Accelerator Lab., Batavia, IL.
EXPERIENCE WITH MODSIM 2
J. Streets, D. Berg, G. Oleynik, R. Pordes, and D. Slimmer Feb. 1992 6 p Presented at the 2nd International Workshop on Software Engineering, Artificial Intelligence (AI), and Neural Nets for High Energy and Nuclear Physics, L'Agelonde, France, 13-18 Jan. 1992
(Contract DE-AC02-76CH-03000)
(DE92-008815; FNAL/C-92/43; CONF-920172-3) Avail: NTIS HC/MF A02

We present results of computer simulations for Data Acquisition systems for large fixed target experiments in an object oriented simulation language, MODSIM. This paper summarizes our experiences and presents preliminary results from the simulation already completed. We also indicate the resources required for this project. DOE

N92-25174*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
A PERFORMANCE STUDY OF SPARSE CHOLESKY FACTORIZATION ON INTEL IPSC/860 Final Report
M. Zubair and M. Ghose (Old Dominion Univ., Norfolk, VA.) Mar. 1992 18 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189634; NAS 1.26:189634; ICASE-92-13) Avail: NTIS HC/MF A03

The problem of Cholesky factorization of a sparse matrix has been very well investigated on sequential machines. A number of efficient codes exist for factorizing large unstructured sparse matrices. However, there is a lack of such efficient codes on parallel machines in general, and distributed machines in particular. Some of the issues that are critical to the implementation of sparse Cholesky factorization on a distributed memory parallel machine are ordering, partitioning and mapping, load balancing, and ordering of various tasks within a processor. Here, we focus on the effect of various partitioning schemes on the performance of sparse Cholesky factorization on the Intel iPSC/860. Also, a new partitioning heuristic for structured as well as unstructured sparse matrices is proposed, and its performance is compared with other schemes. Author

N92-25181 Politecnico di Milano (Italy). Dipartimento di Elettronica.
THE ESSE PROJECT: AN OVERVIEW
Alberto Coen-Porisini, Luigi Lavazza, and Roberto Zicari (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, Germany, F.R.) Dec. 1991 21 p
(Rept-91-077; ETN-92-91261) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A general introduction is presented to the ESSE (Environment Supporting Schema Evolution) project, which aims at developing an advanced integrated software environment for supporting, helping, and advising the software engineer in performing the logical data base design and dynamic schema modifications of an object oriented data base system. Currently available is a running prototype offering a partial set of the required functions (a structural consistency checker, a preliminary version of the behavioral checker), and work is progressing on improving the behavioral checker, adding missing functions, and making the various components part of a truly integrated toolset. The ESSE capabilities may serve as a reference for future evolution of commercial object oriented data base systems. ESA

N92-25182# Technische Univ., Delft (Netherlands).
SEPARATION OF THE USER INTERFACE AND APPLICATION Ph.D. Thesis
Johannes Martinus Versendaal 1991 178 p
(ISBN-90-9004274-1; ETN-92-91287) Copyright Avail: NTIS HC/MF A09

Research on the achievement of a separation of the user interface and application semantics, and the constraints involve therein, is presented. An additional research question concerning the possibility of creating an environment for an interactive computer system develc;per that supports both physical and logical separation, and what kinds of methods, techniques and tools should such an environment provide, is addressed. Two cases are designed and implemented to test the environment. Basic concepts for this research are presented and an alternative model is offered. An environment based on this model is presented and cases that use and test the environment are discussed. The stated research questions are reconsidered taking into account the constructed environment and the implemented cases. ESA

N92-25185* Politecnico di Milano (Italy). Dipartimento di Elettronica.
FUNCTIONAL TEST CASE GENERATION FOR REAL-TIME SYSTEMS
Dino Mandrioli, Sandro Morasca (Maryland Univ., College Park.), and Angelo Morzenti 1992 36 p Sponsored in part by ENEL-CRA and CNR
(Grant NsG-5123)
(NASA-CR-190346; NAS 1.26:190346; Rept-92-008; ETN-92-91368) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The problem of automatic derivation of functional test cases for real time systems is addressed. Techniques for deriving test cases from formal specification of such systems coded in TRIO, a language which extends classical temporal logic to deal explicitly with time measures, are presented. Essentially, the proposed technique consists of generating models (histories) of the axioms specifying the system by means of a suitably specialized interpreter of the language TRIO. Such models are used as test cases by separating input and output events. The problem of testing nondeterministic systems is solved by means of an a posteriori verification performed by the history checker. Several techniques to drastically reduce the size of test cases are proposed. ESA

N92-25186 Politecnico di Milano (Italy). Dipartimento di Elettronica.
MOBY DICK: A FRAMEWORK TO CLASSIFY MODEL-BASED DIAGNOSIS SYSTEMS
Andrea Bonarini and Lorella Colombini Feb. 1992 16 p
(Rept-92-009; ETN-92-91369) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

In recent years, 'model based' approaches to diagnosis proliferated. As this label classifies different proposals, it is getting problematic to compare the characteristics, and to understand where they could be best applied. The Moby Dick (Model Based Systems and Diagnosis: a Classification Key), a framework to define all the elements, which is considered in model based diagnosis is presented. The purpose of the study was to provide a tool to describe all the proposals in the field in a uniform way. This makes

possible comparison of different approaches, and understanding of applicability conditions, and their limits as well, thanks to features expressed by a common language. The following considerations are addressed: no approaches may deal with misbehaviors or with time dependent observations or with type-3 systems; most of them work on structural and functional models in SD sub C and causal models in SD sub F and are interested in static modeling; all of them use models technically described, possibly supported by heuristic models; diagnostic knowledge is implemented algorithmically in most of these approaches; all the systems producing DA-type-3 diagnoses, usually only work till some possible diagnoses are produced, because of computational complexity; there is a general trend to cope with systems completely described, whereas in many applications the identification of models covering all the domain is hard; tests and probes are generally considered essential for the diagnostic activity: also this assumption is valid only for few classes of application; the use of causal SD sub F to have hints about what does not work properly is common, but causal models do not explain how the components misbehave: therefore they are affected by problems similar to heuristic knowledge. ESA

N92-25257*# College of William and Mary, Williamsburg, VA. Dept. of Computer Science.

DESIGN AND ANALYSIS TECHNIQUES FOR CONCURRENT BLACKBOARD SYSTEMS Ph.D. Thesis

John William McManus Apr. 1992 354 p Sponsored by NASA. Langley Research Center

(NASA-CR-190300; NAS 1.26:190300) Avail: NTIS HC/MF A16

Blackboard systems are a natural progression of knowledge-based systems into a more powerful problem solving technique. They provide a way for several highly specialized knowledge sources to cooperate to solve large, complex problems. Blackboard systems incorporate the concepts developed by rule-based and expert systems programmers and include the ability to add conventionally coded knowledge sources. The small and specialized knowledge sources are easier to develop and test, and can be hosted on hardware specifically suited to the task that they are solving. The Formal Model for Blackboard Systems was developed to provide a consistent method for describing a blackboard system. A set of blackboard system design tools has been developed and validated for implementing systems that are expressed using the Formal Model. The tools are used to test and refine a proposed blackboard system design before the design is implemented. My research has shown that the level of independence and specialization of the knowledge sources directly affects the performance of blackboard systems. Using the design, simulation, and analysis tools, I developed a concurrent object-oriented blackboard system that is faster, more efficient, and more powerful than existing systems. The use of the design and analysis tools provided the highly specialized and independent knowledge sources required for my concurrent blackboard system to achieve its design goals. Author

N92-25264*# MCAT Inst., San Jose, CA.

ALGORITHM AND CODE DEVELOPMENT FOR UNSTEADY THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS Annual Report

Shigeru Obayashi Mar. 1992 38 p Original contains color illustrations

(Contract NCC2-605)

(NASA-CR-190077; NAS 1.26:190077; MCAT-92-005) Avail: NTIS HC/MF A03; 2 functional color pages

The code, ENSAERO, is being developed for computing the unsteady aerodynamics and aeroelasticity of aircraft and it solves the Euler/Navier-Stokes equations. During the past year, the code has been applied to transonic flows about complicated geometries, such as flows over a wing-body configuration and a wing with an oscillating control surface. Simulations over a wing-body configuration were performed. The treatment of zonal interface was tested for steady and unsteady cases. The results were validated by comparison with other data. Flows over wing with a moving control surface were computed. The results were validated through comparisons with experimental data. The Baldwin-Barth and Johnson-King models were incorporated into ENSAERO. Author

N92-25266*# Research Inst. for Computing and Information Systems, Houston, TX.

FRAMEWORK PROGRAMMABLE PLATFORM FOR THE ADVANCED SOFTWARE DEVELOPMENT WORKSTATION: PRELIMINARY SYSTEM DESIGN DOCUMENT

Richard J. Mayer, Thomas M. Blinn, Paula S. D. Mayer, Keith A. Ackley, John W. Crump, IV, Richard Henderson, and Michael T. Futrell (Knowledge Based Systems, Inc. College Station, TX.) 13 Dec. 1991 82 p

(Contract NCC9-16; RICIS Proj. SE-37)

(NASA-CR-190176; NAS 1.26:190176) Avail: NTIS HC/MF A05

The Framework Programmable Software Development Platform (FPP) is a project aimed at combining effective tool and data integration mechanisms with a model of the software development process in an intelligent integrated software environment. Guided by the model, this system development framework will take advantage of an integrated operating environment to automate effectively the management of the software development process so that costly mistakes during the development phase can be eliminated. The focus here is on the design of components that make up the FPP. These components serve as supporting systems for the Integration Mechanism and the Framework Processor and provide the 'glue' that ties the FPP together. Also discussed are the components that allow the platform to operate in a distributed, heterogeneous environment and to manage the development and evolution of software system artifacts. Author

N92-25278 Politecnico di Milano (Italy). Dipartimento di Elettronica.

GRAPHS MODELS FOR REACHABILITY ANALYSIS OF CONCURRENT PROGRAMS

M. Pezze, R. Taylor, and M. Young (Purdue Univ., West Lafayette, IN.) Jan. 1992 55 p

(Rept-92-006; ETN-92-91366) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The most used approaches to reachability analysis of concurrent programs, flowgraph and Petri net based approaches, are compared. The approaches are compared from a classical point of view and it is concluded that there is no essential semantic difference between these approaches. It is shown that the differences of the various approaches are not in the way the state space is built, but in the way concurrent programs are represented. Any choice of approach must depend on other factors, like convenience and efficiency. A key factor for the reduction of the stated space is the amount of detail of the concurrent programs that are taken into account. The two approaches are also compared with respect to their suitability for supporting incremental and compositional analysis. It is shown how the results for flowgraph bases approaches can be obtained for Petri net based approaches as well. The various approaches to reachability analysis are equally amenable to techniques for reducing the complexity of the analysis. The Rey techniques for extending reachability analysis for tackling complexity problems for a wide class of systems, regardless of the choice of the model to support the analysis, are described. ESA

N92-25282 Politecnico di Milano (Italy). Dipartimento di Elettronica.

TIES: A TESTABILITY INCREASE EXPERT SYSTEM FOR VLSI DESIGN

Giacomo Buonanno, Franco Fummi, and Donatella Sciuto (Brescia Univ., Italy) Nov. 1991 50 p

(Rept-91-069; ETN-92-91258) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A new approach to the problem of the design of testable structures is proposed: a hierarchical testability analyzer determines testability of the design at the different phases of its development, determining the regions of untestability and the causes. This information is then passed to a design for a testability expert

system which can work at the different levels of abstraction of the design representation. This knowledge based system analyzes the different areas and causes of untestability, then chooses by searching into its knowledge base the best design for testability technique that solves the testability problem, and finally explains to the designer how the result has been derived. The solution satisfies a set of user defined constraints in the final VLSI (Very Large Scale Integration) implementation such as area, pins, time delays requirements. ESA

N92-25287# Technische Univ., Delft (Netherlands).
INTERACTIVE DESIGN OF PARAMETERIZED 3D MODELS BY DIRECT MANIPULATION Ph.D. Thesis
Maarten J. G. M. vanEmmerik 1990 145 p Sponsored by Bouwinformatica TNO
(ISBN-90-6275-633-6; ETN-92-91309) Copyright Avail: NTIS HC/MF A07

The integration of a high level parameterized model representation with direct manipulation interface techniques for the design of three dimensional (3D) objects is addressed. A direct manipulation user interface enables the user to specify a model by interaction on a graphical representation, as an alternative for an abstract and error prone alphanumerical dialogue style. A high level model representation is obtained by using a procedural modeling language with general purpose control structures, including arithmetic and logical expressions, repetition, conditionals, functions and procedures, and dedicated data types such as coordinate systems, geometric primitives and geometric constraints. The language interpreter is interconnected with a graphical interface, an incremental constraint solver and a geometric modeler, using visual programming techniques. The developed techniques are implemented in a modeling system called GeoNode. The system incorporates paradigms of object oriented design, with respect to both the user interface and to the system implementation. The applicability of the presented techniques is illustrated by examples in application domains such as solid modeling, kinematic analysis, feature modeling and topdown design. ESA

N92-25288# Technische Univ., Delft (Netherlands).
REASONING WITH FUZZY LOGIC Ph.D. Thesis
Johannes Hellendoorn 1990 154 p Sponsored by NAL
(ISBN-90-9003771-3; ETN-92-91310) Copyright Avail: NTIS HC/MF A08

An alternative approach to fuzzy logic which puts emphasis on semantical considerations is presented. An introduction on reasoning with fuzzy logic is given. Definitions and the view adopted on fuzzy sets and fuzzy logic are presented. An opinion on the representation of hedges, which has great influence on the working of inference rules in fuzzy logic, is given. The compositional rule of inference and the generalized modus ponens are addressed. ESA

N92-25289# Grenoble-1 Univ. (France). Lab. Structures Discretes et Didactique.
ALGEBRAIC CALCULATION AND PROGRAMMING IN A SPREADSHEET: THE MULTIPLAN CASE Ph.D. Thesis [CALCUL ALGEBRIQUE ET PROGRAMMATION DANS UN TABLEUR: LE CAS DE MULTIPLAN]
Bernard Capponi 1990 283 p In FRENCH
(ETN-92-91313) Avail: NTIS HC/MF A13

Some problems arising from algebraic spreadsheet concepts, in particular due to the equations of the spreadsheet, induce difficulties in the learning of the spreadsheet by students or employees. The use of relative references is the main source of difficulties. A study aimed at the contextualization of the user's algebraic knowledge in a spreadsheet is presented. The study is focused on Multiplan. Some difficulties concerning the learning of the use of this special kind of software are highlighted. The implementation of interaction methods and replication were also studied. ESA

N92-25294 Politecnico di Milano (Italy). Dipartimento di Elettronica.
A NOTE ON MINIMAL DEADLOCK DETECTION IN C/E NETS
Luca Ferrarini and Luca Riva 1992 17 p Sponsored by Italian Ministry of University and Scientific and Technological Research
(Rept-92-005; ETN-92-91365) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

An algorithm for the detection of deadlocks and traps on a Condition/Event (C/E) Petri net is suggested. Such nets are used here to model logic controllers. A specific computer aided design environment was developed. The environment was also endowed with tools for the identification of possible and actual defeats of logic controller design, thanks to the illustrated algorithms. For that reason, only pathological deadlocks and traps were considered. However, the concepts illustrated may be exploited in similar contexts, since the described reasonings are applicable to generic nets. ESA

N92-25302# Technische Univ., Delft (Netherlands).
THE IMPLEMENTATION OF A SYSTEM DESCRIPTION LANGUAGE AND ITS SEMANTIC FUNCTIONS Ph.D. Thesis
C. vanReeuwijk 1991 146 p
(ISBN-90-6275-717-0; ETN-92-91280) Copyright Avail: NTIS HC/MF A07

The design of a language to describe arbitrary systems, called GLASS, is addressed. An important feature of GLASS is that it allows multiple interpretations of the system descriptions. For example, when digital circuits are described in GLASS, it is possible to derive a program from this description to simulate the behavior of a circuit, and for GLASS descriptions of suitable analog circuits, it is possible to derive an input file for circuit simulation programs like Spice. Each of these interpretations is called a 'semantic function'. Because of this feature, GLASS is said to have multiple semantics. Having multiple semantics is only useful if it is easy to define new semantic functions on GLASS. Therefore, difficult parts of a semantic function, such as parsing and correctness checking, should be provided to the author of semantic functions, so that only the essence of the semantic function must be written. For this reason, a program, called Tm, to generate the necessary code to communicate with these parsing and checking programs is developed. Tm is able to generate code for a number of programming languages, providing more flexibility in the implementation of semantic functions. Tm is a general program; it has also been used to generate code for other programs, including Ampdes, a synthesis program for high performance amplifiers which is currently under development. ESA

N92-25303# Technische Univ., Delft (Netherlands).
COMPUTER-AIDED RECOGNITION OF PARTIAL DISCHARGES USING STATISTICAL TOOLS Ph.D. Thesis
Edward Gulski 1991 208 p
(ISBN-90-6275-728-6; ETN-92-91282) Copyright Avail: NTIS HC/MF A10

The improvement of the recognition of discharges by means of computer aided measurements is studied. The specification for a computer aided analysis is discussed and analysis of a number of discharge quantities is proposed. For a partial discharge analyzer based on conventional detection methods, (bandwidth about 400 kHz) relevant design choices are made. The configuration of a computer aided discharge analyzer is presented. A continuous and multiparameter registration is realized. Results on the testing of physical models of discharge sources in gases, liquids, and solid materials with this analyzer are given. The development, a systematic method for the recognition of defects using the statistical operators is reported. The application of the above method to actual technical objects is discussed. The data obtained from tests using the physical models are used in a simple algorithm called the 'recognition rate'. The origin of discharges in actual technical objects could be traced back in this way. ESA

N92-25305# Technische Univ., Delft (Netherlands).
COMPUTER-ASSISTED CARTOGRAPHY FOR MONITORING SPATIO-TEMPORAL ASPECTS OF URBAN AIR POLLUTION Ph.D. Thesis
Alexandra Koussoulakou 18 Dec. 1990 249 p Sponsored in part by IKY
(ISBN-90-6275-650-6; ETN-92-91284) Copyright Avail: NTIS HC/MF A11

The development of a prototype of a software system for the simulation, cartographic processing, and visualization of the causes and results of urban air pollution is addressed. Research on the following are presented: basic cartographic concepts; environmental cartography, air pollution; a cartographic prototype for urban air pollution; synthesis and implementation of the prototype; and a map user test of animated maps. Possible extensions and improvements concerning the visualization, processing, and collection of urban air pollution information are discussed. Conclusions and proposals for user research on animated maps are given. ESA

N92-25306# Technische Univ., Delft (Netherlands).
DELFI: DESIGN, DEVELOPMENT, AND APPLICABILITY OF EXPERT SYSTEMS SHELLS Ph.D. Thesis
Hindrik deSwaanArons 1991 300 p
(ISBN-90-6275-734-0; ETN-92-91295) Copyright Avail: NTIS HC/MF A13

The two rule based systems Delfi2 and Delfi2+ and the frame based system Delfi3 are addressed. The various concepts of knowledge representation, inference, and inexact reasoning are discussed as introduction. The Delfi project is outlined and design and evolution of the above systems are described. The applicability of both rule and frame based expert systems is discussed. Applications in medical diagnosis and therapy, financial advice, and aircraft maintenance are chosen as illustrative examples. The time aspects of expert systems on a real time environment are studied. Online knowledge based scheduling is extensively discussed. ESA

N92-25308# Grenoble-1 Univ. (France). Lab. de Modelisation et de Calcul.
STATISTICAL TOOLS FOR THE EVALUATION OF SOFTWARE RELIABILITY Ph.D. Thesis [OUTILS STATISTIQUES POUR L'EVALUATION DE LA FIABILITE DES LOGICIELS]
Olivier Gaudoin 1990 207 p In FRENCH
(ETN-92-91317) Avail: NTIS HC/MF A10

The purpose of the study was to propose statistical methods for investigating the reliability of a software that is assumed to be a system in which the errors come exclusively from conception problems. A stochastic model is proposed for the behavior of a software as a function of the time, the errors, and the corrections. The model takes into account conception errors and their stimulation process. It is demonstrated that the evolution of the system is the result of the interaction of three punctual random processes. This interaction is given by conditional intensity of the errors. The results show that the reliability of software can be tested by means of comparisons and the use of classical models. Proportional models, which are able to describe in a simple way the effect of a correction on the software error percentage, are developed. The following models are studied: a model in which the effect of a correction is given in a deterministic way; a model applying a Gauss random parameter. The analysis of both models is based on the evaluation of the parameters. Tests to evaluate the tendency of reliability are alo investigated and a new test is proposed. The properties of the 'Laplace' are highlighted. The importance of applying mathematical models to evaluate the optimal reliability is stressed. ESA

N92-25309# Grenoble-1 Univ. (France). Lab. de Modelisation et de Calcul.
ALGORITHM IMPLICITIZATION AND INVERSION METHOD: APPLICATION TO RAY TRACING Ph.D. Thesis [METHODE ALGORITHMIQUE D'IMPLICITISATION ET D'INVERSION: APPLICATION AU LANCER DE RAYONS]
Luc Biard 1990 181 p In FRENCH; ENGLISH summary
(ETN-92-91318) Avail: NTIS HC/MF A09

The implementation and the development of an implicitization and inversion method is presented. An application to the ray tracing of rational parametric surfaces is included. Implicitization is an elimination problem for which the resultant methods appear to be better suited to the application. The Dixon method (1908) for surfaces obtained by tensorial product (bi-degree surfaces) is well adapted. An algorithmic extension of this method, which preserves its properties of simplicity and compactness, is proposed. The implementation in REDUCE language allowed experiments on numerous examples: it shows that the implicit equation is obtained in an efficient way, although the theoretical justification of the algorithm is still incomplete. The study of this justification led to consideration of the problems of unfaithful parameterizations and the appearance of extraneous factors. The inversion problem (identification and determination of the parameters associated to a point of the rational surface) is studied. A numerical application of these algorithms (in C language) to the intersection problem of a rational Bezier patch and a line (ray) is presented. The questions of numerical stability and optimization are addressed. Each surface is associated with a precomputed table allowing an easier way to obtain the intersection equation in the ray parameter. The resulting pictures show the numerical quality of this implicitization inversion method. ESA

N92-25349*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DATA ANALYSIS USING SCALE-SPACE FILTERING AND BAYESIAN PROBABILISTIC REASONING
Deepak Kulkarni, Kiriakos Kutulakos, and Peter Robinson (RECOM Technologies, Inc., Moffett Field, CA.) Mar. 1991 13 p
(NASA-TM-107863; NASA-FIA-91-05; NAS 1.15:107863) Avail: NTIS HC/MF A03

This paper describes a program for analysis of output curves from Differential Thermal Analyzer (DTA). The program first extracts probabilistic qualitative features from a DTA curve of a soil sample, and then uses Bayesian probabilistic reasoning to infer the mineral in the soil. The qualifier module employs a simple and efficient extension of scale-space filtering suitable for handling DTA data. We have observed that points can vanish from contours in the scale-space image when filtering operations are not highly accurate. To handle the problem of vanishing points, perceptual organizations heuristics are used to group the points into lines. Next, these lines are grouped into contours by using additional heuristics. Probabilities are associated with these contours using domain-specific correlations. A Bayes tree classifier processes probabilistic features to infer the presence of different minerals in the soil. Experiments show that the algorithm that uses domain-specific correlation to infer qualitative features outperforms a domain-independent algorithm that does not. Author

N92-25357 Texas Univ., Arlington.
SWEEPLINE ALGORITHM FOR UNSTRUCTURED GRID GENERATION Ph.D. Thesis
Jiunn Fang 1991 110 p
Avail: Univ. Microfilms Order No. DA9208284

The sweepline algorithm, which maintains the O(NlogN) worst case computation complexity, is applied to generate the Delaunay triangulation with N codes in two dimensional (2-D) convex domain. To handle nonconvex domain problems, a modified sweepline algorithm is introduced, which still preserves the optimal computational complexity. The node sets used in the grid generation are generated by tritree and quadtree node generators. The sweep plane algorithm is also developed to construct Delaunay tetrahedra in three dimensional (3-D) convex domains. The worst case computational complexity becomes O(N(exp 2)) and the average computational complexity is O(N(exp 4/3)). The results of 2-D and 3-D tessellation confirm the validity of the present algorithms. Dissert. Abstr.

N92-25359 Politecnico di Milano (Italy). Dipartimento di Elettronica.
DESIGNING AND PROTOTYPING DATA-INTENSIVE APPLICATIONS IN THE LOGRES AND ALGRES PROGRAMMING ENVIRONMENT
F. Cacace, S. Ceri, L. Tanca, and S. CrespiReghizzi 25 Oct. 1991 41 p Sponsored in part by Commission of the European Communities and CNR
(Rept-91-059; ETN-92-91252) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

An environment and a methodology for the design and rapid prototyping of data intensive software applications, that is, applications that perform substantial retrieval and update on persistent data, are presented. In the proposed approach, the application is formally specified using LOGRES, a database language that combines object oriented data modeling and rule based programming. These specifications are translated into ALGRES, an extended relational algebra, thus yielding a rapid, executable prototype. ALGRES programs embedded into a conventional programming language interface may be converted to conventional programs operating on commercial relational systems. This methodology allows automatization of the conversion from declarative requirements to imperative code, thus performing several tasks fully automatically and reducing the probability of human errors. Integrity constraints and application specifications are expressed in a declarative logic language, at a very high level of abstraction. ESA

N92-25361 Politecnico di Milano (Italy). Dipartimento di Elettronica.
IMPROVED ALGORITHM FOR MULTIRATE BENES NETWORKS
L. Favalli 1991 21 p
(Rept-91-061; ETN-92-91254) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The extension to Benes networks with arbitrary switch size of the Balanced Vertex Splitting (BVS) introduced by Melen and Turner for the case of multirate traffic is described. A general coloring algorithm for the connection graph is provided and a formal proof of an upper boundary performance is given. Conclusions are drawn with the auxilium of some graphs. ESA

N92-25379 Physics and Electronics Lab. TNO, The Hague (Netherlands).
VOXEL DATA PROCESSING ON A TRANSPUTER NETWORK Final Report
W. Huiskamp Jun. 1991 120 p
(FEL-91-B166; TD91-2620; ETN-92-91221) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

With the growing availability of three dimensional scanning devices like Computer Tomographs (CT) or Confocal Laser Scanning Microscopes (CLSM) the need for high performance volume data (voxel) processing and display systems increased enormously. The recent development of a fast CLSM required a visualization tool of matching performance. An experimental system that demonstrates the potential of parallel processing for the volume rendering applications was developed. The development, implementation and evaluation of the prototype three dimensional processing system are reported under the following headings: introduction on volume data processing; introduction on transputers and parallel processing; design of the transputer based voxel processing system; implementation of parallel voxel visualization; implementation of parallel image processing algorithms; detailed description of the software; performance evaluation and scalability; future developments. ESA

N92-25384*# Research Inst. for Computing and Information Systems, Houston, TX.
REPOSITORY-BASED SOFTWARE ENGINEERING (RBSE) PROGRAM Final Report
27 Jan. 1992 10 p Prepared in cooperation with Applied Expertise, Inc., Houston, TX
(Contract NCC9-16; RICIS Proj. IM-17)
(NASA-CR-190169; NAS 1.26:190169) Avail: NTIS HC/MF A02

Support of a software engineering program was provided in the following areas: client/customer liaison; research representation/outreach; and program support management. Additionally, a list of deliverables is presented. Author

N92-25406*# Research Inst. for Computing and Information Systems, Houston, TX.
IDEF3 FORMALIZATION REPORT
Christopher Menzel, Richard J. Mayer, and Douglas D. Edwards (Texas A&M Univ., College Station.) 6 Mar. 1991 57 p
(Contract NCC9-16; RICIS Proj. IM-06)
(NASA-CR-190280; NAS 1.26:190280) Avail: NTIS HC/MF A04

The Process Description Capture Method (IDEF3) is one of several Integrated Computer-Aided Manufacturing (ICAM) DEFinition methods developed by the Air Force to support systems engineering activities, and in particular, to support information systems development. These methods have evolved as a distillation of 'good practice' experience by information system developers and are designed to raise the performance level of the novice practitioner to one comparable with that of an expert. IDEF3 is meant to serve as a knowledge acquisition and requirements definition tool that structures the user's understanding of how a given process, event, or system works around process descriptions. A special purpose graphical language accompanying the method serves to highlight temporal precedence and causality relationships relative to the process or event being described. Author

N92-25430*# Research Inst. for Computing and Information Systems, Houston, TX.
CLASSIFICATION OF POSTURE MAINTENANCE DATA WITH FUZZY CLUSTERING ALGORITHMS Final Report, 1 Feb. 1991 - 31 Jan. 1992
James C. Bezdek (University of West Florida, Pensacola.) 31 Jan. 1992 54 p
(Contract NCC9-16; RICIS Proj. AI-19)
(NASA-CR-189940; NAS 1.26:189940) Avail: NTIS HC/MF A04

Sensory inputs from the visual, vestibular, and proprioreceptive systems are integrated by the central nervous system to maintain postural equilibrium. Sustained exposure to microgravity causes neurosensory adaptation during spaceflight, which results in decreased postural stability until readaptation occurs upon return to the terrestrial environment. Data which simulate sensory inputs under various sensory organization test (SOT) conditions were collected in conjunction with Johnson Space Center postural control studies using a tilt-translation device (TTD). The University of West Florida applied the fuzzy c-means (FCM) clustering algorithms to this data with a view towards identifying various states and stages of subjects experiencing such changes. Feature analysis, time step analysis, pooling data, response of the subjects, and the algorithms used are discussed. Author

N92-25438*# Research Inst. for Computing and Information Systems, Houston, TX.
NASA PROJECT ICON IMAGE ACCESS AND MANAGEMENT, YEAR 2 Status Interim Report
20 Dec. 1988 11 p Prepared in cooperation with Texas Univ., Austin
(Contract NCC9-16; RICIS Proj. IM-10)
(NASA-CR-190283; NAS 1.26:190283) Avail: NTIS HC/MF A03

Viewgraphs used in a presentation of the NASA Project Icon Image Access and Management are given. The viewgraphs depict the opening screen that allows the user to start searching the thesaurus; a schematic of the the NASA image input/output workstation; the main term screen that allows the user to view the term and the associated pictures, enter the term into the search buffer, and go to one of the linked terms; the main input screen that allows the user to enter new terms, edit terms, and add pictures and links between terms; the term index that allows the user to select a term by scrolling through an alphabetic list of all the terms in the thesaurus; the results screen that shows the

results of the search on the external database; the screen buffer that displays a list of all the search terms collected while browsing through the thesaurus; and the picture index that allows the user to select a term by scrolling through the list of pictures stored in the visual thesaurus. Author

N92-25444*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
KNOWLEDGE-INTENSIVE SOFTWARE DESIGN SYSTEMS: CAN TOO MUCH KNOWLEDGE BE A BURDEN?
Richard M. Keller Apr. 1992 8 p Proposed for presentation in the Working Notes of the AAAI-92 Workshop on Automating Software Design, San Jose, CA, 12 Jul. 1992
(NASA-TM-107853; NASA-FIA-92-11; NAS 1.15:107853) Avail: NTIS HC/MF A02

While acknowledging the considerable benefits of domain-specific, knowledge-intensive approaches to automated software engineering, it is prudent to carefully examine the costs of such approaches, as well. In adding domain knowledge to a system, a developer makes a commitment to understanding, representing, maintaining, and communicating that knowledge. This substantial overhead is not generally associated with domain-independent approaches. In this paper, I examine the downside of incorporating additional knowledge, and illustrate with examples based on our experiences building the SIGMA system. I also offer some guidelines for developers building domain-specific systems. Author

N92-25474# Sandia National Labs., Albuquerque, NM.
ANVILTOL: INTERACTIVE COMPUTER-AIDED TOLERANCE ANALYSIS AND SYNTHESIS FOR ANVIL 5000
R. H. Robison Dec. 1991 26 p
(Contract DE-AC04-76DP-00789)
(DE92-009884; SAND-91-1866) Avail: NTIS HC/MF A03

This document describes a software application that utilizes an Anvil 5000 CAD model to interactively perform computer-aided tolerance analysis and synthesis. Using AnvilTOL, the designer models a tolerance stack-up as a vector loop by graphically selecting geometric and tolerance data directly from an Anvil5000 CAD model. The tolerance model can then be analyzed by worst case or statistical models. AnvilTOL also performs tolerance synthesis by re-allocating part tolerances by the methods of proportional scaling or constant precision factor. Precision spacers may also be automatically designed for selective assembly processes. DOE

N92-25503*# Research Inst. for Computing and Information Systems, Houston, TX.
ISyCL TECHNICAL REPORT
Louis P. Decker and Richard J. Mayer (Texas A&M Univ., College Station.) 8 Mar. 1991 112 p
(Contract NCC9-16; RICIS Proj. IM-06)
(NASA-CR-190281; NAS 1.26:190281) Copyright Avail: NTIS HC/MF A06

The Air Force Integrated Information Systems Evolution Environment (IISEE) is a program focused on the development of technology for enabling the planning definition development and maintenance of evolutionary integrated information systems. This program has studied the representational needs of this knowledge base from the point of view of the needs of engineering, manufacturing, and logistics Evolutionary Information Systems (EIS). The definition of the concepts for a suite of automated tools and environments to support the pursuit of such engineering, manufacturing, and logistics EIS's has also required examination of languages and representation schemes for the knowledge base of these integrated systems. To accomplish this purpose, the language must be very rich, and must support object orientation, relational orientation, persistent storage, process transaction specification, and first order logic. The task of designing a unified language which supports these paradigms is a challenge. The Information Systems Constraint Language (ISyCL) is described. It was designed to meet the definitional and knowledge representation needs of three perspectives. It supports users from the area expert to the data base designer. Author

N92-25513# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
COMPOSITIONAL STATE SPACE GENERATION
A. Valmari Oct. 1991 38 p Prepared in cooperation with Technical Research Centre of Finland, Espoo
(PB92-151877; A-1991-5; ISBN-951-45-5910-X) Avail: NTIS HC/MF A03

Compositional state space generation means the generation of a condensed version of the state space of a system in a compositional manner. The system is divided into parts. The state spaces of the parts are generated, condensed, and composed to get a state space of the system. The method may be applied recursively; i.e., the state spaces of the parts may have been generated compositionally. The generated condensed state space is in a certain sense equivalent with the ordinary state space, thus it can be used for the analysis of certain properties of the system. Compositional state space generation is a very desirable goal because it has the potential to significantly increase the size of systems analyzable with given computer resources. The theoretical and technical prerequisites of compositional state space generation methods are discussed. Then one particular method is developed. The method guarantees that the composed state spaces are equivalent in the sense of the theory of Communicating Sequential Processes (CSP) with the corresponding ordinary state spaces. Therefore the method is suitable for the analysis of the language and deadlock properties of systems which are not expected to execute infinite sequences of invisible transitions. Author

N92-25514# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
LEARNING DECISION TREES FROM NOISY EXAMPLES
T. Elomaa and J. Kivinen Aug. 1991 23 p
(PB92-151851; A-1991-3; ISBN-951-45-5865-0) Avail: NTIS HC/MF A03

The learnability is proved of decision trees of fixed rank in the presence of random classification noise. Ehrenfeucht and Haussler have presented an algorithm that learns decision trees of fixed rank probably approximately correctly from correct (noiseless) examples. They modifiy the algorithm slightly in order to achieve a noise tolerant Occam algorithm for decision trees of fixed rank. Sakakibara has shown that the existence of a noise tolerant Occam algorithm implies learnability in the presence of random classification noise. He has used this technique to prove the related result that decision lists are learnable from noisy examples. Author

N92-25519# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Aerodynamics.
TRANSF3: A 3-D GRID GENERATOR BASED ON TRANSFINITE INTERPOLATION
R. Lehtimaeki 19 Dec. 1991 41 p
(PB92-151919; SER-B-91-B34; ISBN-951-22-0903-9) Avail: NTIS HC/MF A03

A 3-D single block algebraic grid generator was developed. The transfinite interpolation method is used. The surface grids on each (or some) of the six block faces are required as input. The method may be used for multi-block grids where the inter-block boundaries have been predetermined. The basic theory of transfinite interpolation is presented. Instructions for running the grid generation program are given. Also, a sample case is presented. Author

N92-25525# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
COMPARISON OF APPROXIMATE STRING MATCHING ALGORITHMS
P. Jokinen, J. Tarhio, and E. Ukkonen 1991 30 p
(PB92-151885; A-1991-7; ISBN-951-45-5976-2) Avail: NTIS HC/MF A03

Experimental comparison of the running time of approximate string matching algorithms for the k differences problem is presented. Given a pattern string, a text string, and an integer k, the task is to find all approximate occurrences of the pattern in the text with at most k differences (insertion, deletions, changes). Besides a new algorithm based on suffix automata, six other algorithms are considered which are based on different approaches including dynamic programming, Boyer-Moore string matching, and the distribution of characters. It turns out that none of the algorithms is the best for all values of the problem parameters, and the speed differences between the methods can be large. Author

N92-25526# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
ORDERED AND UNORDERED TREE INCLUSION
P. Kilpelaeinen and H. Mannila Aug. 1991 30 p
(PB92-151869; A-1991-4; ISBN-951-45-5866-9) Avail: NTIS HC/MF A03

The following problem is considered: Given labeled trees P and T, can P be obtained from T by deleting nodes. Deleting a node v entails removing all edges incident to v, and if v has a parent u, replacing the edge from u to v by edges from u to the children of v. The problem is motivated by the study of query languages for structured text data bases. Simple solutions to the problem require exponential time. For ordered trees, they represent an algorithm that requires O(P T) time and space. They also consider the corresponding problem for unordered trees and give a proof of its NP-completeness. Author

N92-25609*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Computer Science.
OPTIMIZATION BY NONHIERARCHICAL ASYNCHRONOUS DECOMPOSITION Final Report, 16 Jan. 1990 - 31 May 1992
Jayashree Shankar, Calvin J. Ribbens, Raphael T. Haftka, and Layne T. Watson 26 May 1992 15 p
(Grant NAG1-1079)
(NASA-CR-190338; NAS 1.26:190338) Avail: NTIS HC/MF A03

Large scale optimization problems are tractable only if they are somehow decomposed. Hierarchical decompositions are inappropriate for some types of problems and do not parallelize well. Sobieszczanski-Sobieski has proposed a nonhierarchical decomposition strategy for nonlinear constrained optimization that is naturally parallel. Despite some successes on engineering problems, the algorithm as originally proposed fails on simple two dimensional quadratic programs. The algorithm is carefully analyzed for quadratic programs, and a number of modifications are suggested to improve its robustness. Author

N92-25636*# Chicago Univ., IL.
THE ANALYSIS OF CONTROL TRAJECTORIES USING SYMBOLIC AND DATABASE COMPUTING Semiannual Status Report, 1 Jul. - 31 Dec. 1991
Robert Grossman Mar. 1991 10 p
(Grant NAG2-513)
(NASA-CR-190234; NAS 1.26:190234) Avail: NTIS HC/MF A02

The research broadly concerned the symbolic computation, mixed numeric-symbolic computation, and data base computation of trajectories of dynamical systems, especially control systems. It was determined that trees can be used to compute symbolically series which approximate solutions to differential equations. Author

N92-25731*# Arizona State Univ., Tempe. Center for Systems Science and Engineering.
A THIRD ORDER RUNGE-KUTTA ALGORITHM ON A MANIFOLD
P. E. Crouch, R. G. Grossman, and Y. Yan Mar. 1992 9 p
(Grant NAG2-513)
(NASA-CR-190330; NAS 1.26:190330) Avail: NTIS HC/MF A02

A third order Runge-Kutta type algorithm is described with the property that it preserves certain geometric structures. In particular, if the algorithm is initialized on a Lie group, then the resulting iterates remain on the Lie group. Author

N92-25738*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COBWEB/3: A PORTABLE IMPLEMENTATION
Kathleen McKusick and Kevin Thompson (Sterling Software, Moffett Field, CA.) 17 Sep. 1990 73 p
(NASA-TM-107861; NASA-FIA-90-6-18-2; NAS 1.15:107861)
Avail: NTIS HC/MF A04

An algorithm is examined for data clustering and incremental concept formation. An overview is given of the Cobweb/3 system and the algorithm on which it is based, as well as the practical details of obtaining and running the system code. The implementation features a flexible user interface which includes a graphical display of the concept hierarchies that the system constructs. Author

N92-25936# Technische Univ., Delft (Netherlands). Pattern Recognition Section.
DISTANCE TRANSFORMS: METRICS, ALGORITHMS AND APPLICATIONS Ph.D. Thesis
Bernard Johanna Hend Verwer 1991 107 p
(ISBN-90-6275-697-2; ETN-92-91240) Copyright Avail: NTIS HC/MF A06

Subjects covered were: an efficient uniform cost algorithm applied to distance transforms; local distances for distance transformation in two and three dimensions; a contour processing method for fast binary neighborhood operations; improved metrics in image processing applied to the Hilditch skeleton; two dimensional adaptive smoothing by three dimensional distance transformation; shading from shape, the eikonal equation solved by gray weighted distance transform; heuristic search in robot configuration space using variable metric; and a multiresolution work space, multiresolution configuration space approach to solve the path planning problem. For individual titles, see N92-25937 through N92-25944.

N92-25937# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
AN EFFICIENT UNIFORM COST ALGORITHM APPLIED TO DISTANCE TRANSFORMS
Bernard Johanna Hend Verwer, Piet W. Verbeek, and Simon T. Dekker *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 13-20 Repr. from IEEE Transactions on Pattern Analysis and Machine Intelligence, v. 11, no. 4, 1989 p 425-429 Sponsored by Netherlands Government Revised (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

An efficient version of the uniform cost algorithm was developed for integer cost values. Nodes were sorted by storing them at predefined places, keeping the overhead low. The algorithm was applied to general distance transformation. It is shown that a constrained distance transform is an operation which calculates at each pixel of an image, the distance to the nearest pixel of a reference set. The uniform cost algorithm, in the constrained case, proved to be the best solution for distance transformation, as it is fast, the processing time is independent of the complexity of the image and memory requirements are moderate. ESA

N92-25938# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
LOCAL DISTANCES FOR DISTANCE TRANSFORMATIONS IN TWO AND THREE DIMENSIONS
Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 21-33 Submitted for publication Sponsored by Netherlands Government (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

A unified treatment is presented for determining the distance between two points in a two or three dimensional digitized space. A distance transformation is used, which is based on a sequence of optimal local distances. The optimal distance is derived in the context of minimizing the maximum error and the unbiased mean square error. Integer approximations for the local distances are developed for neighborhood sizes of three and five. Minimization

is performed over circles and spheres to preserve the symmetries of the neighborhood. Whereas the differences with previously published results are small in two dimensions, new results are obtained in three dimensions. ESA

N92-25939# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
A CONTOUR PROCESSING METHOD FOR FAST BINARY NEIGHBOURHOOD OPERATIONS
Lucas J. vanVliet and Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 35-46 Repr. from Pattern Recognition Letters, v. 7, 1988 p 27-36 (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

New fast algorithms for erosion dilation, propagation and skeletonization are presented. A queue is implemented to store the contours in each iteration for the next iteration. Contour filling and object labeling become available by minor modifications of the basic operations. It is shown that the time complexity of the algorithms is linear with the number of contour elements to be processed. The new fast algorithms proved to be faster than any other known algorithm. ESA

N92-25940# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
IMPROVED METRICS ON IMAGE PROCESSING APPLIED TO THE HILDITCH SKELETON
Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 47-54 Repr. from IEEE Proceedings 9th International Conference on Pattern Recognition, 1988 p 137-142 Presented at the 9th International Conference on Pattern Recognition, Rome, Italy, 14-17 Nov. 1988 (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

An algorithm is presented in which binary object pixels are addressed and processed in order of increasing distance to the background. The distances are defined as path lengths. The algorithm incorporates an efficient propagation method, in which extensive use is made of directional information. The algorithm is applied to the Hilditch skeleton and proves to be as fast as the best other Hilditch skeleton algorithms available in software. ESA

N92-25941# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
TWO DIMENSIONAL ADAPTIVE SMOOTHING BY 3-D DISTANCE TRANSFORMATION
Piet W. Verbeek and Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 59-73 Repr. from Pattern Recognition Letters, v. 9, 1989 p 53-65 Revised (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

The adaptation by first smoothing was pursued at all sizes and the best result was selected. The usual implementation was described. It is shown that the medial axis approach allows extension to local adaptation, unlike the usual implementation which can only be extended to global adaptation. The number of objects or features left over after smoothing was proposed as a scale invariant criterion for smoothing heaviness. The medial axis was broken up into countable fragments related to image segments, whose importance could be estimated from the values on the medial axis fragment. A given number of most important segments could be selected for local small size closing. ESA

N92-25942# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
SHADING FROM SHAPE: THE EIKONAL EQUATION SOLVED BY GREY-WEIGHTED DISTANCE TRANSFORM
Piet W. Verbeek and Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 75-89 Repr. from Pattern Recognition Letters, v. 11, 1990 p 681-690 (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

A new fast method for the calculation of an approximative solution of the eikonal equation is presented. Shading form shape, e.g., another kind of image display based on solving an eikonal equation, was found. The construction of a matte three dimensional surface was proposed, which yields a gray value field when illuminated perpendicularly and imaged in eye or camera. The gray value field renders the image. This method was applied on a recent design for a Dutch coin. ESA

N92-25943# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
HEURISTIC SEARCH IN ROBOT CONFIGURATION SPACE USING VARIABLE METRIC
Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 91-103 Repr. from NASA Conference Publication, no. 2492 p 153-154 Presented at the 3rd Conference on Artificial Intelligence for Space Applications, Huntsville, AL, 1-12 Nov. 1987 (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

A method to generate collision free paths for mobile robots and for manipulator robots is proposed. The method finds paths in a digitized configuration space using the A algorithm. The metric in the configuration space is adjusted to obtain a tradeoff between safety and velocity. Simulations are shown for three dimensional configuration spaces. ESA

N92-25944# Technische Univ., Delft (Netherlands). Pattern Recognition Group.
A MULTIRESOLUTION WORK SPACE, MULTIRESOLUTION CONFIGURATION SPACE APPROACH TO SOLVE THE PATH PLANNING PROBLEM
Bernard Johanna Hend Verwer *In its* Distance Transforms: Metrics, Algorithms and Applications 1991 p 105-112 Repr. from Proceedings 1990 IEEE International Conference on Robotics and Automation p 2107-2112 Presented at the 1990 IEEE International Conference on Robotics and Automation, Cincinatti, OH, 13-18 May 1990 Sponsored by Netherlands Government (For primary document see N92-25936 16-61)
Copyright Avail: NTIS HC/MF A06

The algorithm SCOUT is proposed to solve the path planning problem for robots moving between stationary obstacles. The configuration space is explored independently from start and goal until a contiguous path of free blocks connecting the two is found. The algorithm finds a first path quickly, then improves on the length of the path by testing more parts of the configuration space, and converges to the optical path for any imposed metric. The method is applicable to mobile robots and to manipulators. Results are shown for a two degrees of freedom planar arm, and a five degrees of freedom industrial manipulator. ESA

N92-25980# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
AUTOMATED SOFTWARE GENERATION APPROACHES FOR THE DESIGN AND DEVELOPMENT OF GUIDANCE AND CONTROL SYSTEMS SOFTWARE [LES DIFFERENTES APPROCHES GENERATION POUR LA CONCEPTION ET LE DEVELOPPEMENT DE LOGICIELS DE GUIDAGE ET DE PILOTAGE]
Edwin B. Stear, ed. and John T. Shepherd, ed. (GEC-Marconi Ltd., Borehamwood, England) Mar. 1992 188 p (AGARD-AR-292; ISBN-92-835-0663-4) Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

This advisory report summarizes the findings and conclusions of Working Group 10 of the Guidance and Control Panel of AGARD, the terms of reference which were: (1) to develop and consider a set of requirements for application of software generators for guidance control systems, (2) to evaluate the characteristics and capabilities offered by existing application software generator technology with respect to the requirements defined in (1), and (3) if required, to determine the modifications and improvements

necessary for such technology to meet the requirements defined in (1). The working group defined and investigated four approaches to software generation: reusable software modules, expert systems, program transformation techniques, and fourth generation languages. Author

N92-25984*# Research Inst. for Computing and Information Systems, Houston, TX.
IDEF5 ONTOLOGY DESCRIPTION CAPTURE METHOD: CONCEPT PAPER
Christopher P. Menzel and Richard J. Mayer (Texas A&M Univ., College Station.) 1990 34 p
(Contract NCC9-16; RICIS Proj. IM-06)
(NASA-CR-190285; NAS 1.26:190285) Copyright Avail: NTIS HC/MF A03

The results of research towards an ontology capture method referred to as IDEF5 are presented. Viewed simply as the study of what exists in a domain, ontology is an activity that can be understood to be at work across the full range of human inquiry prompted by the persistent effort to understand the world in which it has found itself - and which it has helped to shape. In the contest of information management, ontology is the task of extracting the structure of a given engineering, manufacturing, business, or logistical domain and storing it in an usable representational medium. A key to effective integration is a system ontology that can be accessed and modified across domains and which captures common features of the overall system relevant to the goals of the disparate domains. If the focus is on information integration, then the strongest motivation for ontology comes from the need to support data sharing and function interoperability. In the correct architecture, an enterprise ontology base would allow th e construction of an integrated environment in which legacy systems appear to be open architecture integrated resources. If the focus is on system/software development, then support for the rapid acquisition of reliable systems is perhaps the strongest motivation for ontology. Finally, ontological analysis was demonstrated to be an effective first step in the construction of robust knowledge based systems. Author

N92-26018*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
ITERATIVE METHODS FOR LARGE SCALE STATIC ANALYSIS OF STRUCTURES ON A SCALABLE MULTIPROCESSOR SUPERCOMPUTER Final Report, period ended 31 May 1992
Nahil Atef Sobh Jun. 1992 15 p
(Grant NAG1-1291)
(NASA-CR-190369; NAS 1.26:190369) Avail: NTIS HC/MF A03

A parallel Preconditioned Conjugate Gradient (PCG) iterative solver has been developed and implemented on the iPSC-860 scalable hypercube. This new implementation makes use of the Parallel Automated Runtime Toolkit at ICASE (PARTI) primitives to efficiently program irregular communications patterns that exist in general sparse matrices and in particular in the finite element sparse stiffness matrices. The iterative PCG has been used to solve the finite element equations that result from discretizing large scale aerospace structures. In particular, the static response of the High Speed Civil Transport (HSCT) finite element model is solved on the iPSC-860. H.A.

N92-26042# New Mexico State Univ., Las Cruces. Computing Research Lab.
ACTIVE KNOWLEDGE STRUCTURES FOR NATURAL LANGUAGE PROCESSING Final Report
Yorick Wilks, Michael Coombs, Roger T. Hartley, and Dihong Qiu 1991 16 p
(Contract N00014-89-J-1558)
(AD-A245893) Avail: NTIS HC/MF A03

ViewGen is a dynamic beliefs management system. It generates multiple belief environments from different points of view. The basic inference mechanism in ViewGen is default reasoning: unless there is evidence to the contrary, the agents are assumed to have the same beliefs as the system. CP is a general knowledge representation system. It allows data, as facts, and domain knowledge, as definitions, to be separated, but it does not allow for nested beliefs: CP only allows reasoning from one point of view, instead of allowing multiple viewpoints, as ViewGen does. An integrated reasoning system has been designed which combines CP and ViewGen, and a prototype system has been implemented. A discussion of the architecture of the system, and the representation and organization of belief and knowledge is presented. First, we present an overview of the capabilities of conceptual programming and give a simple example of the representations it uses. GRA

N92-26072*# Virginia Univ., Charlottesville. Dept. of Computer Science.
DEVELOPMENT AND VALIDATION OF TECHNIQUES FOR IMPROVING SOFTWARE DEPENDABILITY Annual Progress Report, 1 Apr. 1991 - 31 Mar. 1992
John C. Knight Jun. 1992 12 p
(Grant NAG1-1123)
(NASA-CR-190361; NAS 1.26:190361; UVA/528344/CS92/102)
Avail: NTIS HC/MF A03

A collection of document abstracts are presented on the topic of improving software dependability through NASA grant NAG-1-1123. Specific topics include: modeling of error detection; software inspection; test cases; Magnetic Stereotaxis System safety specifications and fault trees; and injection of synthetic faults into software. H.A.

N92-26074# Naval Postgraduate School, Monterey, CA.
FUNCTION ALLOCATION IN A ROBUST DISTRIBUTED REAL-TIME ENVIRONMENT M.S. Thesis
Karen K. Lehman Dec. 1991 108 p
(AD-A245768) Avail: NTIS HC/MF A06

Critical real-time computing systems are characterized by a stringent set of reliability and performance requirements. Distributed systems, often defined to encompass a broad class of loosely coupled computer systems, are an effective means of achieving reliability and increasing system throughput. Among the many desirable characteristics that can be achieved at the application level using such a system are dynamic response to changing processing loads of functions (tasks) and exploitation of inherent parallelism using distribution. In these systems, functions must be assigned and scheduled in an attempt to be completed prior to their deadlines. Initial assignment of functions to processors (nodes) must not preclude their subsequent dynamic reassignment/reconfiguration in response to load changes or failure/repair. These allocation and reconfiguration methodologies are as diverse as their applications. A technique to manage the complexity of building such a system is a layered architecture with reconfiguration accomplished by an individual layer of software. GRA

N92-26075# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
CUTTING PLANE ALGORITHMS FOR MAXIMUM PROBLEMS
Siriphong Lawphongpanich and Donald W. Hearn Dec. 1991 46 p
(Contract NPSOR-92-008)
(AD-A245788) Avail: NTIS HC/MF A03

This paper unifies the development of the cutting plane algorithm for mathematical programs and variational inequalities by providing one common framework for establishing convergence. Strategies for generating cuts are provided for cases in which the algorithm yields easy and difficult subproblems. When the subproblem is easy to solve, a line search is added and a deep cut is selected to accelerate the algorithm. On the other hand, when the subproblem is difficult to solve, the problem is only solved approximately during the early iterations. This corresponds to generating cuts which are nontangential to the underlying objective function. Moreover, in the case of variational inequalities, it is shown further that the subproblem can be eliminated entirely from the algorithmic steps, thereby, making the resulting algorithm especially advantageous. GRA

N92-26091# Lawrence Livermore National Lab., CA.
ASSIST SYSTEM ANALYSIS
J. B. Pane Oct. 1991 13 p
(Contract W-7405-eng-48)
(DE92-009469; UCRL-CR-109234) Avail: NTIS HC/MF A03

Estimate is a Nomad shared database application which is invoked as a subsystem of an 'umbrella' application called ASSIST. Estimate is used to develop, run, and review budget plans and at peak times will have 15-20 users accessing the system. The application has shown problems in performance, particularly when more than 5 users are on the system, and with memory management. Memory abends are at times random but when they occur users are forced to re-enter their work. MUST Software International was pleased to respond to the Lab's request to help analyze and resolve these problems. The objective was to make changes where necessary to improve performance without redesigning or making significant coding changes to Estimate. Recommendations for design and coding changes are noted and are included in this report. But there are still memory build-ups that exist when moving between the develop and run sides of the application. These memory problems need to be resolved and may require program restructuring. Recommendations in this area are detailed in this report. DOE

N92-26115*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COLLECTED NOTES ON THE WORKSHOP FOR PATTERN DISCOVERY IN LARGE DATABASES
Wray Buntine, ed. and Martha DelAlto, ed. (Research Inst. for Advanced Computer Science, Moffett Field, CA.) Apr. 1991 156 p Workshop held in Moffett Field, CA, 14-15 Jan. 1991 Sponsored in part by Research Inst. for Advanced Computer Science
(NASA-TM-107909; NASA-FIA-91-07; NAS 1.15:107909)
Copyright Avail: NTIS HC/MF A08

These collected notes are a record of material presented at the Workshop. The core data analysis is addressed that have traditionally required statistical or pattern recognition techniques. Some of the core tasks include classification, discrimination, clustering, supervised and unsupervised learning, discovery and diagnosis, i.e., general pattern discovery. Author

N92-26116*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NASA TILEWORLD MANUAL (SYSTEM VERSION 2.2)
Andrew B. Philips and John L. Bresina (Sterling Federal Systems, Inc., Moffett Field, CA.) Sep. 1991 52 p
(DARPA Order 7382)
(NASA-TM-107907; NASA-FIA-91-11; NAS 1.15:107907) Avail: NTIS HC/MF A04

The commands are documented of the NASA TileWorld simulator, as well as providing information about how to run it and extend it. The simulator, implemented in Common Lisp with Common Windows, encodes a particular range in a spectrum of domains, for controllable research experiments. TileWorld consists of a two dimensional grid of cells, a set of polygonal tiles, and a single agent which can grasp and move tiles. In addition to agent executable actions, there is an external event over which the agent has not control; this event correspond to a 'gust of wind'. Author

N92-26117*# Cleveland State Univ., OH. Dept. of Computer and Information Science.
METHODOLOGY FOR OBJECT-ORIENTED REAL-TIME SYSTEMS ANALYSIS AND DESIGN: SOFTWARE ENGINEERING Final Technical Report, Oct. 1990 - Oct. 1991
James D. Schoeffler Oct. 1991 36 p
(Grant NAG3-1145)
(NASA-CR-190260; NAS 1.26:190260) Avail: NTIS HC/MF A03

Successful application of software engineering methodologies requires an integrated analysis and design life-cycle in which the various phases flow smoothly 'seamlessly' from analysis through design to implementation. Furthermore, different analysis methodologies often lead to different structuring of the system so that the transition from analysis to design may be awkward depending on the design methodology to be used. This is especially important when object-oriented programming is to be used for implementation when the original specification and perhaps high-level design is non-object oriented. Two approaches to real-time systems analysis which can lead to an object-oriented design are contrasted: (1) modeling the system using structured analysis with real-time extensions which emphasizes data and control flows followed by the abstraction of objects where the operations or methods of the objects correspond to processes in the data flow diagrams and then design in terms of these objects; and (2) modeling the system from the beginning as a set of naturally occurring concurrent entities (objects) each having its own time-behavior defined by a set of states and state-transition rules and seamlessly transforming the analysis models into high-level design models. A new concept of a 'real-time systems-analysis object' is introduced and becomes the basic building block of a series of seamlessly-connected models which progress from the object-oriented real-time systems analysis and design system analysis logical models through the physical architectural models and the high-level design stages. The methodology is appropriate to the overall specification including hardware and software modules. In software modules, the systems analysis objects are transformed into software objects. Author

N92-26120*# Research Inst. for Computing and Information Systems, Houston, TX.
IDEF4 TECHNICAL REPORT, VERSION 1.0
Richard J. Mayer and Douglas D. Edwards (Texas A&M Univ., College Station.) 1990 51 p
(Contract NCC9-16; RICIS Proj. IM-06)
(NASA-CR-190287; NAS 1.26:190287) Copyright Avail: NTIS HC/MF A04

A language for the representation of object oriented software designs is described. IDEF4, a methodology for object-oriented design, is being developed as a design tool for software designers who use such object-oriented languages. Such languages include the Common LISP Object System, Flavors, C++, Smalltalk, Objective C, and others. Since effective usage of the object-oriented paradigm requires a different thought process than that used with conventional procedural or database languages, standard methodologies such as structure charts, data flow diagrams, and traditional data design models (hierarchical, relational, and network) are not sufficient. IDEF4 seeks to provide the necessary facilities to support the object-oriented design decision making process. Specifically, the two primary design goals of IDEF4 are: (1) to provide support for creating object oriented designs whose implementations will exhibit desirable life cycle qualities and reduce total implementation development time; and (2) to make it easy to evaluate object oriented code to determine whether or not the delivered product both conforms to the design and exhibits the desired life cycle qualities. The application of IDEF4 in the life cycle of a software development project is intended to be focused on those activities after a decision has been made to employ object oriented programming technology, but prior to detailed code specification. Author

N92-26136# Auburn Univ., AL.
RSSP: A FORTRAN SIMULATION PACKAGE FOR USE IN TEACHING RESPONSE SURFACE METHODOLOGY M.S. Thesis
James T. Treharne 12 Jun. 1991 108 p
(AD-A245569) Avail: NTIS HC/MF A06

The Response Surface Simulation Package (RSSP) consists of three FORTRAN programs that assist in the teaching of Response Surface Methodology. The programs operate on an IBM (or compatible) personal computer. The package helps bridge the gap between theory and practice which is often difficult to do in a classroom setting. The thesis details the background and objectives of the computer package and a review of Response Surface Methodology theory. The simulation package assumes the user has a sufficient background in experimental design, multiple linear

regression, and analysis of variance. The thesis also includes the FORTRAN source code for the programs as well as detailed instructor and student manuals. Further, sample outputs from the three programs are provided. A major objective of this work is to make the programs user friendly, for both the instructor and student. This allows the student to gain a great deal of knowledge about practical experimental design and Response Surface Methodology. GRA

N92-26144# Massachusetts Univ., Amherst. Dept. of Computer and Information Science.
SYMBOLIC IMAGE UNDERSTANDING Final Report, Sep. 1987 - Aug. 1990
Ed Riseman and Al Hanson Nov. 1991 33 p
(Contract F30602-87-C-0140)
(AD-A245661; RL-TR-91-304) Avail: NTIS HC/MF A03

This report summarizes the work done at the University of Massachusetts in the area of Image Understanding of static scene domains. The goal of this research project was to demonstrate a practical knowledge-based approach to computer vision that utilized multiple levels of parallel processing. Some problems dealt with included extracting lines, grouping together regions and lines from the same surface, computing pose from geometry, and matching corresponding features in different views. Special attention was also given to the extraction of curved lines and curved surfaces. The static scene domains consisted of both ROAD and HOUSE scenes, each containing approximately fourteen (14) different objects per scene. GRA

N92-26156# National Inst. of Standards and Technology, Gaithersburg, MD. Process Measurements Div.
SPECTRAL ANALYSIS ON A PC Final Report
D. E. Hess Dec. 1991 76 p
(PB92-162270; NISTIR-4733) Avail: NTIS HC/MF A05

These notes are intended to serve as a brief instruction manual for engineers engaged in the spectral analysis of experimentally-derived random data. A collection of techniques are described which are necessary for the proper software implementation of spectral analysis procedures on a personal computer: data transformation, mean value and linear trend removal, digital filtering, time history tapering, and data overlapping. The various spectral density functions are then defined and explained along with a means for the calculation of the error associated with a particular estimate. Several detailed examples are included which serve to illustrate the methods described. The manual also contains a brief description of the considerations necessary when sampling the data to be analyzed. Author

N92-25715*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
QX MAN: Q AND X FILE MANIPULATION
Mark A. Krein *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 29-33 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25724*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTERACTIVE SOLUTION-ADAPTIVE GRID GENERATION PROCEDURE
Yung K. Choo and Todd Henderson *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 123-138 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25726*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACTIVITIES FOR NUMERICAL PROPULSION SYSTEMS SIMULATION PROGRAM
Austin L. Evans *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 151-157 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25847# GEC Alsthom, Whetstone (England). Engineering Research Centre.
ESARAD: THE EUROPEAN SPACE AGENCY'S RADIATIVE ANALYSER
J. J. Rebis, P. T. Warren, and P. Jeanne (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 173-178 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25848# MATRA Marconi Space, Toulouse (France).
COMPUTATION OF THERMAL RADIATION ON SPACECRAFT WITH MOBILE PARTS
P. Renard, E. Ajdari, and C. Puillet *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 179-186 (For primary document see N92-25828 16-18)
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N92-25849# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
MANAGEMENT OF VARIABLE GEOMETRY IN THERMAL ANALYSIS OF COMMUNICATION EQUIPMENT WITH ROTATING PARTS, PARTS 1 AND 2
L. Borucki, E. Hanka, F. Zilly, H. Bachmann, and R. Seeliger (ANT Nachrichtentechnik, Backnang, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 187-192 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25870# Aerospatiale, Cannes (France). Div. des Systemes Strategiques.
FLUIDNET-G: A GRAPHIC SOFTWARE FOR THE PRELIMINARY SIZING OF FLUID LOOPS NETWORKS
J. N. Chelotti, S. Andre, T. Maciaszek, A. Thuaire, and A. Ferro (Societe Regionale d'Informatique Industrielle, Valbonne, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 341-347 Sponsored by CNES (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25871# GEC Alsthom, Whetstone (England). Engineering Research Centre.
FHTS: ACTIVE THERMAL CONTROL ANALYSER VERIFICATION, VALIDATION, AND UPGRADE
C. J. Kirtley, Y. Boillot, and A. Lebru (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 349-356 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25872# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
FIRST EXPERIENCE WITH FHTS APPLICATION FOR SYSTEM ANALYSIS (COLUMBUS MTFF) AND COMPONENT DEVELOPMENT (HERMES WEA)
M. Gralher, B. Haase, and G. Kleinert-Alvarado *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 357-371 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25873# Centre National d'Etudes Spatiales, Toulouse (France).
PRESENTATION OF CEDRIC: COMPARISON WITH OTHER CODES FOR SINGLE PHASE ANALYSIS
Thierry Maciaszek, Joel Gayrard, and Gilles Barges (Commissariat a l'Energie Atomique, Aix-en-Provence, France) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 Dec. 1991 p 373-380 (For primary document see N92-25828 16-18)
Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

N92-25913*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTER CODES DEVELOPED AND UNDER DEVELOPMENT AT LEWIS
Christos C. Chamis *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems May 1992 p 43-57 (For primary document see N92-25911 16-39)
Avail: NTIS HC/MF A22

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-25281 Politecnico di Milano (Italy). Dipartimento di Elettronica.
SYNTHESIS OF MULTIPLE OUTPUT CMOS COMBINATIONAL GATES
Giacomo Buonanno Nov. 1991 39 p
(Rept-91-068; ETN-92-91257) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Design of multiple outputs CMOS combinatorial gates is studied. Two techniques for minimization of multiple output functions at the switching level are introduced. These techniques are based on innovative transistor interconnection structures named Delta and Lambda networks. The two techniques can be combined together to obtain further area reductions. Different synthesis algorithms are discussed, from exhaustive enumeration to branch and bound to heuristic techniques allowing speed up of the synthesis process. Simulation results for synthesis are introduced to compare the different algorithms. Design examples are also provided. Electrical simulations show that the behavior of such a structure is analogous to the traditional static or domino implementations. ESA

N92-25283 Politecnico di Milano (Italy). Dipartimento di Elettronica.
INNOVATIVE STRUCTURES FOR CMOS COMBINATIONAL GATES SYNTHESIS
Giacomo Buonanno, Donatella Sciuto (Brescia Univ., Italy), and R. Stefanelli Nov. 1991 29 p
(Rept-91-070; ETN-92-91259) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Design of multiple outputs CMOS combinatorial gates is studied. Two techniques for minimization of multiple output functions at the switching level are introduced. These techniques are based on innovative transistor interconnection structures named Delta and Lambda networks. The two techniques can be combined together to obtain further area reductions. Different synthesis algorithms are discussed, from exhaustive enumeration to branch and bound to heuristic techniques allowing speed up of the synthesis process. Simulation results for synthesis are introduced to compare the different algorithms. Design examples are also provided. Electrical simulations show that the behavior of such a structure is analogous to the traditional static or domino implementation. ESA

N92-25291 Politecnico di Milano (Italy). Dipartimento di Elettronica.
PRODUCTION RULES IN PARALLEL AND DISTRIBUTED DATABASE ENVIRONMENTS
Stefano Ceri and Jennifer Widom (International Business Machines Corp., San Jose, CA.) Jan. 1992 31 p
(Rept-92-001; ETN-92-91361) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The mechanisms that allow time processing to occur separately at each site and guarantee correctness are described: parallel or distributed rule processing is probably equivalent to rule processing in the corresponding centralized environment. Mechanisms include locking schemes, communication protocols, and rule restrictions. Based on a given parallel or distributed environment and desired level of transparancy, the mechanisms may be combined or may be used independently. The production rule language and rule processing semantics of the starburst rule system are described. The following distributed environments are studied: mechanisms whereby rules can reference data at multiple sites, mechanisms whereby each site can independently initiate rule processing, mechanisms for intersite rule priorities. A proof of correctness is included. Parallel environment and an additional notion of rule 'partitionability' are discussed. Conclusions and proposed future work are included. ESA

N92-25405*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
FAULT-TOLERANT WAIT-FREE SHARED OBJECTS
Prasad Jayanti, Tushar D. Chandra, and Sam Toueg Apr. 1992 34 p
(Grants NAG2-593; NSF CCR-89-01780; NSF CCR-91-02231) (NASA-CR-190261; NAS 1.26:190261; CU-TR-92-1281) Avail: NTIS HC/MF A03

A concurrent system consists of processes communicating via shared objects, such as shared variables, queues, etc. The concept of wait-freedom was introduced to cope with process failures: each process that accesses a wait-free object is guaranteed to get a response even if all the other processes crash. However, if a wait-free object 'crashes,' all the processes that access that object are prevented from making progress. In this paper, we introduce the concept of fault-tolerant wait-free objects, and study the problem of implementing them. We give a universal method to construct fault-tolerant wait-free objects, for all types of 'responsive' failures (including one in which faulty objects may 'lie'). In sharp contrast, we prove that many common and interesting types (such as queues, sets, and test&set) have no fault-tolerant wait-free implementations even under the most benign of the 'non-responsive' types of failure. We also introduce several concepts and techniques that are central to the design of fault-tolerant concurrent systems: the concepts of self-implementation and graceful degradation, and techniques to automatically increase the fault-tolerance of implementations. We prove matching lower bounds on the resource complexity of most of our algorithms. Author

N92-25428 Politecnico di Milano (Italy). Dipartimento di Elettronica.
HIGH-SPEED PARALLEL INPUT-OUTPUT BIT-SLICED CONVOLVERS
Luigi Dadda Nov. 1991 25 p
(Rept-91-030; ETN-92-91246) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A family of convolvers for high samples rates, based in the composition of subconvolvers characterized by one bit samples and by modular, regular structures decomposable in identical bit slices is proposed. Samples are represented in parallel or in skew form and the whole circuit is a sequential circuit whose combinatorial part is an array of full adders, assuring a high sampling rate. ESA

N92-25450 Politecnico di Milano (Italy). Dipartimento di Elettronica.
HIERARCHICAL AND MODULATED PETRI NETS FOR MANUFACTURING SYSTEMS SIMULATION [RETI DI PETRI GERARCHICHE E MODULARI PER LA SIMULAZIONE DI SISTEMI DI PRODUZIONE]
Giovanni Righini Nov. 1991 48 p In ITALIAN
(Rept-91-062; ETN-92-91255) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Two definitions relating respectively to modulated networks and hierarchical networks are presented. In both cases a notable freedom exists in the definition of the concept of subnetworks. Their significance and use in the formal analysis of model properties and in the possible carrying out of simulations are discussed. An application in a flexible manufacturing system simulation demonstrates this concept. ESA

N92-25451 Politecnico di Milano (Italy). Dipartimento di Elettronica.
HIGH-SPEED SKEW INPUT-OUTPUT CONVOLVER
Luigi Dadda Nov. 1991 19 p
(Rept-91-066; ETN-92-91256) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A convolver scheme based on a linear array of pipelined 'skew' input-outputs multipliers is presented. The n bit skew samples are represented on n distinct wires as for numbers in parallel form, the least significant bit being transmitted at first, followed in time sequence by the remaining bits at regular intervals, as in the serial form. The output convolutions appear with the same format at n' = 2n + (log(sub 2)N) ports, being computed in integer arithmetic. The bit rate, equal to the sample rate, is determined by the sum of one full adder and one flip-flop delay. ESA

N92-25467# Lawrence Livermore National Lab., CA.
ELROS: AN EMBEDDED LANGUAGE FOR REMOTE OPERATIONS SERVICE
M. L. Branstetter, J. A. Guse, and D. M. Nessett Nov. 1991 13 p Presented at the 1992 International Federation of Information Processing (IFIP) Conference on Upper Layer Protocols, Architectures and Applications, Vancouver, British Columbia, 25-29 May 1992
(Contract W-7405-eng-48)
(DE92-007343; UCRL-JC-108862; CONF-920583-1) Avail: NTIS HC/MF A03

We describe ELROS, an embedded language for programming distributed applications using remote operations (ISO 9072-1 and 9072-2). The motivation of this work is the development of both large scale scientific distributed applications as well as ISO application protocol implementations. We compare our work with other systems, such as ISODE and DAS, that support remote operations programming and point out certain advantages of ELROS. Finally, we suggest ways in which the current implementation of ELROS can be improved. DOE

N92-25512 Politecnico di Milano (Italy). Dipartimento di Elettronica.
A SIMPLIFIED HIGH SPEED PARALLEL INPUT CONVOLVER
Luigi Dadda Nov. 1991 26 p
(Rept-91-031; ETN-92-91247) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A parallel input-parallel output convolver previously proposed, based on an array of subconvolvers characterized by one bit samples (one bit convolvers) and implemented as arrays of carry save accumulators, is addressed. Each array computes the sum of the rows of the multiplication arrays of the convolution products obtained with a given multiplier bit. A modified scheme, in which the overflows generated on the accumulation of the rows of each product in the different one bit convolvers are grouped in a single number with all of these numbers being accumulated in a specific accumulators array, is presented. Two different schemes based on this principle are presented. These new schemes are shown to offer a substantial saving in the number of components, and the bit convolvers have a more regular structure over the previous schemes. The proposed schemes use a skew, least significant bit first arithmetic and achieve a samples rate equal to the clock rate. ESA

N92-25574 Michigan Univ., Ann Arbor.
EVALUATION OF COMMUNICATION STRUCTURES IN LARGE-SCALE MULTICOMPUTER NETWORKS Ph.D. Thesis
Bryan Eric Aupperle 1991 136 p
Avail: Univ. Microfilms Order No. DA9208487

Computer network design is a difficult and multifaceted problem. The designer must select a combination of architecture and protocols to meet a specific need. To do this task properly, many potential networks need to be evaluated and compared in terms of performance and reliability criteria. This evaluation can be done most effectively and efficiently via modeling. Unfortunately, current modeling techniques are tied closely to specific architectures, and so do not readily permit meaningful comparisons across broad classes of networks. Moreover, architecture specific models become intractable when faults are introduced, making evaluation of degradable performance impossible. Dissert. Abstr.

N92-25965*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
GENERALIZED HYPERCUBE STRUCTURES AND HYPERSWITCH COMMUNICATION NETWORK
Steven D. Young Washington Jun. 1992 15 p
(NASA-TM-4380; L-16984; NAS 1.15:4380) Avail: NTIS HC/MF A03

This paper discusses an ongoing study that uses a recent development in communication control technology to implement hybrid hypercube structures. These architectures are similar to binary hypercubes, but they also provide added connectivity between the processors. This added connectivity increases communication reliability while decreasing the latency of interprocessor message passing. Because these factors directly determine the speed that can be obtained by multiprocessor systems, these architectures are attractive for applications such as remote exploration and experimentation, where high performance and ultrareliability are required. This paper describes and enumerates these architectures and discusses how they can be implemented with a modified version of the hyperswitch communication network (HCN). The HCN is analyzed because it has three attractive features that enable these architectures to be effective: speed, fault tolerance, and the ability to pass multiple messages simultaneously through the same hyperswitch controller. Author

N92-26105*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
ADVANCED INFORMATION PROCESSING SYSTEM: FAULT INJECTION STUDY AND RESULTS Final Report
Laura F. Burkhardt, Thomas K. Masotto, and Jaynarayan H. Lala May 1992 164 p
(Contract NAS1-18565)
(NASA-CR-189590; NAS 1.26:189590) Avail: NTIS HC/MF A08

The objective of the AIPS program is to achieve a validated fault tolerant distributed computer system. The goals of the AIPS fault injection study were: (1) to present the fault injection study components addressing the AIPS validation objective; (2) to obtain feedback for fault removal from the design implementation; (3) to obtain statistical data regarding fault detection, isolation, and reconfiguration responses; and (4) to obtain data regarding the effects of faults on system performance. The parameters are described that must be varied to create a comprehensive set of fault injection tests, the subset of test cases selected, the test case measurements, and the test case execution. Both pin level hardware faults using a hardware fault injector and software injected memory mutations were used to test the system. An overview is provided of the hardware fault injector and the associated software used to carry out the experiments. Detailed specifications are given of fault and test results for the I/O Network and the AIPS Fault Tolerant Processor, respectively. The results are summarized and conclusions are given. Author

N92-26126*# ORA Corp., Ithaca, NY.
MOVING FORMAL METHODS INTO PRACTICE. VERIFYING THE FTPP SCOREBOARD: RESULTS, PHASE 1
Mandayam Srivas and Mark Bickford May 1992 61 p
(Contract NAS1-18972)
(NASA-CR-189607; NAS 1.26:189607) Avail: NTIS HC/MF A04

This report documents the Phase 1 results of an effort aimed at formally verifying a key hardware component, called Scoreboard, of a Fault-Tolerant Parallel Processor (FTPP) being built at Charles Stark Draper Laboratory (CSDL). The Scoreboard is part of the FTPP virtual bus that guarantees reliable communication between processors in the presence of Byzantine faults in the system. The Scoreboard implements a piece of control logic that approves and validates a message before it can be transmitted. The goal of Phase 1 was to lay the foundation of the Scoreboard verification. A formal specification of the functional requirements and a high-level hardware design for the Scoreboard were developed. The hardware design was based on a preliminary Scoreboard design developed at CSDL. A main correctness theorem, from which the functional requirements can be established as corollaries, was proved for the Scoreboard design. The goal of Phase 2 is to verify the final detailed design of Scoreboard. This task is being conducted as part of a NASA-sponsored effort to explore integration of formal methods in the development cycle of current fault-tolerant architectures being built in the aerospace industry.
Author

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-25190*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONSTRAINT-BASED SCHEDULING
Monte Zweben Sep. 1991 19 p
(NASA-TM-107873; NASA-FIA-91-27; NAS 1.15:107873) Avail: NTIS HC/MF A03

The GERRY scheduling system developed by NASA Ames with assistance from the Lockheed Space Operations Company, and the Lockheed Artificial Intelligence Center, uses a method called constraint based iterative repair. Using this technique, one encodes both hard rules and preference criteria into data structures called constraints. GERRY repeatedly attempts to improve schedules by seeking repairs for violated constraints. The system provides a general scheduling framework which is being tested on two NASA applications. The larger of the two is the Space Shuttle Ground Processing problem which entails the scheduling of all inspection, repair, and maintenance tasks required to prepare the orbiter for flight. The other application involves power allocations for the NASA Ames wind tunnels. Here the system will be used to schedule wind tunnel tests with the goal of minimizing power costs. In this paper, we describe the GERRY system and its applications to the Space Shuttle problem. We also speculate as to how the system would be used for manufacturing, transportation, and military problems.
Author

N92-25201*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF A MACHINE VISION SYSTEM FOR AUTOMATED STRUCTURAL ASSEMBLY
P. Daniel Sydow and Eric G. Cooper May 1992 30 p
(NASA-TM-4366; L-16995; NAS 1.15:4366) Avail: NTIS HC/MF A03

Research is being conducted at the LaRC to develop a telerobotic assembly system designed to construct large space truss structures. This research program was initiated within the past several years, and a ground-based test-bed was developed to evaluate and expand the state of the art. Test-bed operations currently use predetermined ('taught') points for truss structural assembly. Total dependence on the use of taught points for joint receptacle capture and strut installation is neither robust nor reliable enough for space operations. Therefore, a machine vision sensor guidance system is being developed to locate and guide the robot to a passive target mounted on the truss joint receptacle. The vision system hardware includes a miniature video camera, passive targets mounted on the joint receptacles, target illumination hardware, and an image processing system. Discrimination of the target from background clutter is accomplished through standard digital processing techniques. Once the target is identified, a pose estimation algorithm is invoked to determine the location, in three-dimensional space, of the target relative to the robots end-effector. Preliminary test results of the vision system in the Automated Structural Assembly Laboratory with a range of lighting and background conditions indicate that it is fully capable of successfully identifying joint receptacle targets throughout the required operational range. Controlled optical bench test results indicate that the system can also provide the pose estimation accuracy to define the target position.
Author

N92-25290# Grenoble-1 Univ. (France).
SPATIAL KNOWLEDGE BASED SYSTEMS: APPLICATION TO THE ANALYSIS OF AVALANCHE PATHS Ph.D. Thesis [LE RAISONNEMENT SPATIAL DANS LES SYSTEMES A BASE DE CONNAISSANCES: APPLICATION A L'ANALYSE DE SITES AVALANCHEUX]
Laurent Buisson 1990 181 p In FRENCH; ENGLISH summary
(ETN-92-91314) Avail: NTIS HC/MF A09

Spatial knowledge can be defined through a classification which shows the large part played by topology. Three forms of spatial reasoning can be identified in several different application domains: topology building, inferences of spatial properties and localization of objects. Knowledge based systems can handle data and inference mechanisms involved in those three kinds of spatial reasoning and, as a result, support such a reasoning. Its dependencies graph has some features which imply a management of the dynamicity of spatial knowledge bases. The results of inferences must be recorded and the truth maintenance requested by this caching can take advantage of a locality concept defined in the graph. These conclusions are based on the experience of the development of ELSA (French acronym for study and limits of avalanche paths). Some other domains can use spatial knowledge bases: symbolic modeling of spatial phenomena, problem solving environments and geographic knowledge bases. ELSA uses an object centered knowledge representation which is well adapted, even if some extensions appear useful, such as interobjects relations, constructive pattern matching and open query languages. Those extensions are interesting not only for spatial information handling but also for other kind of knowledge. This suggests that, far from specific, spatial reasoning reveals some needs of general reasoning.
ESA

N92-25301# Technische Univ., Delft (Netherlands).
WHAT IS ON THE MACHINE'S MIND? MODELS FOR REASONING WITH INCOMPLETE AND UNCERTAIN KNOWLEDGE Ph.D. Thesis
Nicolaas Roos 1992 134 p Sponsored by NAL
(ISBN-90-9003079-1; ETN-92-91279) Copyright Avail: NTIS HC/MF A07

A nonmonotonic logic, called preference logic, which combines the advantages of some existing approaches while avoiding some of their disadvantages, is described. A deduction process, in which reason maintenance is integrated, is defined for the logic. A way of looking at a reasoning process, which is more intuitive and where the consistency problem is decidable for a partial model, is proposed. The foundations for such a complete framework only are described, since many problems remain unsolved. The approach is proposed as an interesting alternative.
ESA

N92-25408*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TELEROBOTIC HAND CONTROLLER STUDY OF FORCE REFLECTION WITH POSITION CONTROL MODE
Kelli F. Willshire, Walter W. Hankins, A. Terry Morris, and Randolph W. Mixon Mar. 1992 18 p Presented at the Ergonomics Society Annual Conference, Birmingham, England, 7-10 Apr. 1992
(NASA-TM-107569; NAS 1.15:107569) Avail: NTIS HC/MF A03

To gain further information about the effectiveness of kinesthetic force feedback or force reflection in position control mode for a telerobot, two Space Station related tasks were performed by eight subjects with and without the use of force reflection. Both time and subjective responses were measured. No differences due to force were found, however, other differences were found, e.g., gender. Comparisons of these results with other studies are discussed. Author

N92-25416# Oak Ridge National Lab., TN.
TIME OPTIMAL PATHS FOR A CONSTANT SPEED UNICYCLE
D. B. Reister 1991 14 p Presented at the IEEE International Conference on Robotics and Automation, Nice, France, 10-15 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-000071; CONF-920540-10) Avail: NTIS HC/MF A03

This paper uses the Pontryagin maximum principle to find time optimal paths for a constant speed unicycle. The time optimal paths consist of sequences of arcs of circles and straight lines. The maximum principle introduces the following concepts: dual variables; bang-bang solutions; singular solutions; and transversality conditions. The solutions provide important insight into the nature of the time optimal paths. DOE

N92-25417# Oak Ridge National Lab., TN.
AUTONOMOUS NAVIGATION OF A MOBILE ROBOT USING CUSTOM-DESIGNED QUALITATIVE REASONING VLSI CHIPS AND BOARDS
F. G. Pin, R. S. Pattay, H. Watanabe, and J. Symon (North Carolina Univ., Chapel Hill.) 1991 14 p Presented at the IEEE International Conference on Robotics and Automation, Nice, France, 10-15 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-000072; CONF-920540-6) Avail: NTIS HC/MF A03

Two types of computer boards, including custom-designed VLSI chips, were developed to add a qualitative reasoning capability to the real-time control of autonomous mobile robots. The design and operation of these boards are first described and an example of their use for the autonomous navigation of a mobile robot is presented. The development of qualitative reasoning schemes emulating human-like navigation in a-priori unknown environments is discussed. The efficiency of such schemes, which can consist of as little as a dozen qualitative rules, is illustrated in experiments involving an autonomous mobile robot navigating on the basis of very sparse inaccurate sensor data. DOE

N92-25418# Sandia National Labs., Albuquerque, NM.
SANDROS: A MOTION PLANNER WITH PERFORMANCE PROPORTIONAL TO TASK DIFFICULTY
Pang C. Chen and Yong K. Hwang 10 Sep. 1991 15 p Presented at the IEEE International Conference on Robotics and Automation, Nice, France, 10-15 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-000229; SAND-91-1871C; CONF-920540-12) Avail: NTIS HC/MF A03

To address the need of a practical motion planner for manipulators, we present an efficient and resolution-complete algorithm that has performance commensurate with task difficulty. The algorithm uses SANDROS, a new search strategy that combines hierarchical, nonuniform-multi-resolution, and best-fit searches to find a near-optimal solution in the configuration space. This algorithm can be applied to any manipulator, and has been tested with 5- and 6-degree-of-freedom robots, with execution time ranging from 20 seconds to 10 minutes on a 16 MIPS workstation. DOE

N92-25419# Oak Ridge National Lab., TN.
A SYSTEM FOR SIMULATING SHARED MEMORY IN HETEROGENEOUS DISTRIBUTED-MEMORY NETWORKS WITH SPECIALIZATION FOR ROBOTICS APPLICATIONS
J. P. Jones, A. L. Bangs, and P. L. Butler 1991 10 p Presented at the IEEE International Conference on Robotics and Automation, Nice, France, 10-15 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-000433; CONF-920540-11) Avail: NTIS HC/MF A02

Hetero Helix is a programming environment which simulates shared memory on a heterogeneous network of distributed-memory computers. The machines in the network may vary with respect to their native operating systems and internal representation of numbers. Hetero Helix presents a simple programming model to developers, and also considers the needs of designers, system integrators, and maintainers. The key software technology underlying Hetero Helix is the use of a 'compiler' which analyzes the data structures in shared memory and automatically generates code which translates data representations from the format native to each machine into a common format, and vice versa. The design of Hetero Helix was motivated in particular by the requirements of robotics applications. Hetero Helix has been used successfully in an integration effort involving 27 CPUs in a heterogeneous network and a body of software totaling roughly 100,00 lines of code. DOE

N92-25420# Sandia National Labs., Albuquerque, NM.
A CAPACITANCE-BASED PROXIMITY SENSOR FOR WHOLE ARM OBSTACLE AVOIDANCE
J. L. Novak and J. T. Feddema 1991 21 p Presented at the IEEE International Conference on Robotics and Automation, Nice, France, 10-15 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-000820; SAND-91-2119C; CONF-920540-14) Avail: NTIS HC/MF A03

This paper addresses the issue of collision avoidance in unknown or partially modeled environments using a capacitive sensor. An eight channel capacitance-based sensor system which can detect obstacles up to 400 mm (16 inches) away has been developed. This sensor can detect both conductive and non-conductive obstacles of arbitrary color and shape. The sensor hardware is reliable and inexpensive, and it may be fabricated using flexible printed circuit boards to provide whole-arm and joint protection for any robot or manipulator. Simple collision avoidance control algorithms have been implemented on a two-link robot arm. The sensor and control system enable the robot arm to avoid a conductive post and a concrete block. DOE

N92-25443*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE MIN-CONFLICTS HEURISTIC: EXPERIMENTAL AND THEORETICAL RESULTS
Steven Minton, Andrew B. Philips, Mark D. Johnston (Space Telescope Science Inst., Baltimore, MD.), and Philip Laird Sep. 1991 27 p
(NASA-TM-107877; NASA-FIA-91-25; NAS 1.15:107877) Avail: NTIS HC/MF A03

This paper describes a simple heuristic method for solving large-scale constraint satisfaction and scheduling problems. Given an initial assignment for the variables in a problem, the method operates by searching through the space of possible repairs. The search is guided by an ordering heuristic, the min-conflicts heuristic, that attempts to minimize the number of constraint violations after each step. We demonstrate empirically that the method performs orders of magnitude better than traditional backtracking techniques on certain standard problems. For example, the one million queens problem can be solved rapidly using our approach. We also describe practical scheduling applications where the method has been successfully applied. A theoretical analysis is presented to explain why the method works so well on certain types of problems and to predict when it is likely to be most effective. Author

N92-25456# Uppsala Univ. (Sweden). Programming Methodology and Artificial Intelligence Lab.
PERSISTENT DATA STORAGE FOR PROLOG
Monika Danielsson and Jonas Barklund 9 Jul. 1990 17 p Presented at DEXA 1990, the International Conference on Data Base and Expert Systems Applications, Vienna, Austria, 29-31 Aug. 1990 Original contains color illustrations
(UPMAIL-TR-62; ISSN-1100-0686) Avail: NTIS HC/MF A03

To provide persistent data storage for Prolog programs, we propose a simple interface between Prolog and relational data bases with SQL. The intention has been to make relations stored in the data base tables behave as much as possible like relations defined by Prolog clauses, except for ordering of solutions. We introduce a syntactical device for simplifying translation of data base relations to efficient SQL queries, and we describe the translation. A non-trivial problem has been to implement backtracking over data base relations, simulating the behavior of Prolog. We suggest three different implementations and provide some benchmark figures for two of them. The data base system and our Prolog system are two components of a distributed tool for writing applications such as expert systems. Author

N92-25524# Helsinki Univ. of Technology, Espoo (Finland). Systems Analysis Lab.
MULTI-AGENT INTERACTION PROCESSES: FROM OLIGOPOLY THEORY TO DECENTRALIZED ARTIFICIAL INTELLIGENCE
M. Verkama, R. P. Haemaelaeinen, and H. Ehtamo Nov. 1991 31 p
(PB92-151489; A-42; ISBN-951-22-0877-6) Avail: NTIS HC/MF A03

Similarities are addressed between the problems of oligopoly theory and decentralized artificial intelligence (DzAI). The behavior of autonomous interacting agents is an important issue in both of these areas of research. Among the many questions of interest are ways of reaching cooperation by a group of decentralized agents. The authors think that many models and results of oligopoly theory could prove to be useful in DzAI. Especially, the important idea of reshaping goals with knowledge sharing, or incentive communications, has received little attention in AI. On the other hand, oligopoly theory and experimental economics, in particular, can benefit from the computational methods and tools of AI. To demonstrate this they have built a prototype of an experimental market analysis environment. Some potential goal relaxation techniques for goal conflict situations are illustrated. Author

N92-25552# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
ROBUST ADAPTIVE CONTROLLER FOR ROBOT MANIPULATORS
H. Berghuis, R. Ortega, and H. Nijmeijer Aug. 1991 15 p Prepared in cooperation with McGill Univ., Montreal, Quebec Sponsored by Stichting voor de Technische Wetenschappen, Utrecht, Netherlands
(PB92-148709; MEMO-992) Avail: NTIS HC/MF A03

The paper proposes a globally convergent adaptive control scheme for robot motion control with the following features: (1) the adaptation law possesses enhanced robustness with respect to noisy velocity measurements; (2) the controller does not require the inclusion of high gain loops that may excite the unmodeled dynamics and amplify the noise level; and (3) it derives for the known parameter design a relationship between compensator gains and closed-loop convergence rates which is independent of the robot task. This helps the designer to carry out the gain tuning with an eye on the robustness-performance tradeoff. GRA

N92-25553# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
OBSERVER DESIGN IN THE TRACKING CONTROL PROBLEM OF ROBOTS
H. Berghuis, H. Nijmeijer, and P. Loehnberg Sep. 1991 21 p Sponsored by Stichting voor de Technische Wetenschappen, Utrecht (Netherlands)
(PB92-148725; MEMO-994) Avail: NTIS HC/MF A03

Full state feedback is the starting point for the majority of currently available control methods for rigid robots, an assumption that can hardly be realized in practice due to the poor quality of velocity measurements. This work considers the tracking control problem for robots using only position measurements. Some known state feedback controllers are modified by integrating a velocity observer in the loop, thereby yielding an exponentially stable closed loop system without the need for high gain assumptions. The removed requirement for velocity measurements, and thereby for expensive velocity data-acquisition hardware, makes the presented control methods interesting from an economic point of view. GRA

N92-25739*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE BLIND LEADING THE BLIND: MUTUAL REFINEMENT OF APPROXIMATE THEORIES
Smadar T. Kedar, John L. Bresina, and C. Lisa Dent (Carnegie-Mellon Univ., Pittsburgh, PA.) Apr. 1991 8 p Submitted for publication
(NASA-TM-107880; NASA-FIA-91-09; NAS 1.15:107880) Avail: NTIS HC/MF A02

The mutual refinement theory, a method for refining world models in a reactive system, is described. The method detects failures, explains their causes, and repairs the approximate models which cause the failures. The approach focuses on using one approximate model to refine another. Author

N92-25740*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXPERIMENTATION IN MACHINE DISCOVERY
Deepak Kulkarni and Herbert A. Simon (Carnegie-Mellon Univ., Pittsburgh, PA.) 1 Sep. 1990 19 p Submitted for publication
(Contract F33615-87-C-1499)
(NASA-TM-107874; NASA-FIA-90-09-24-02; NAS 1.15:107874)
Avail: NTIS HC/MF A03

KEKADA, a system that is capable of carrying out a complex series of experiments on problems from the history of science, is described. The system incorporates a set of experimentation strategies that were extracted from the traces of the scientists' behavior. It focuses on surprises to constrain its search, and uses its strategies to generate hypotheses and to carry out experiments. Some strategies are domain independent, whereas others incorporate knowledge of a specific domain. The domain independent strategies include magnification, determining scope, divide and conquer, factor analysis, and relating different anomalous phenomena. KEKADA represents an experiment as a set of independent and dependent entities, with apparatus variables and a goal. It represents a theory either as a sequence of processes or as abstract hypotheses. KEKADA's response is described to a particular problem in biochemistry. On this and other problems, the system is capable of carrying out a complex series of experiments to refine domain theories. Analysis of the system and its behavior on a number of different problems has established its generality, but it has also revealed the reasons why the system would not be a good experimental scientist. Author

N92-25741*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE ENTROPY REDUCTION ENGINE: INTEGRATING PLANNING, SCHEDULING, AND CONTROL
Mark Drummond, John L. Bresina, and Smadar T. Kedar (Sterling Federal Systems, Inc., Moffett Field, CA.) Feb. 1991 8 p Submitted for publication
(DARPA Order 7382)
(NASA-TM-107867; NASA-FIA-91-17; NAS 1.15:107867) Avail: NTIS HC/MF A02

The Entropy Reduction Engine, an architecture for the integration of planning, scheduling, and control, is described. The architecture is motivated, presented, and analyzed in terms of its different components; namely, problem reduction, temporal

projection, and situated control rule execution. Experience with this architecture has motivated the recent integration of learning. The learning methods are described along with their impact on architecture performance. Author

N92-25742*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANYTIME SYNTHETIC PROJECTION: MAXIMIZING THE PROBABILITY OF GOAL SATISFACTION
Mark Drummond and John L. Bresina (Rutgers Univ., New Brunswick, NJ.) May 1990 10 p Submitted for publication
Sponsored in part by AFOSR
(NASA-TM-107866; NASA-FIA-91-19; NAS 1.15:107866) Avail: NTIS HC/MF A02

A projection algorithm is presented for incremental control rule synthesis. The algorithm synthesizes an initial set of goal achieving control rules using a combination of situation probability and estimated remaining work as a search heuristic. This set of control rules has a certain probability of satisfying the given goal. The probability is incrementally increased by synthesizing additional control rules to handle 'error' situations the execution system is likely to encounter when following the initial control rules. By using situation probabilities, the algorithm achieves a computationally effective balance between the limited robustness of triangle tables and the absolute robustness of universal plans. Author

N92-25966*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AUTOMATIC LEARNING RATE ADJUSTMENT FOR SELF-SUPERVISING AUTONOMOUS ROBOT CONTROL
Michael K. Arras, Peter W. Protzel (Institute for Computer Applications in Science and Engineering, Hampton, VA.), and Daniel L. Palumbo Mar. 1992 9 p
(Contract NAS1-18605)
(NASA-TM-107592; NAS 1.15:107592) Avail: NTIS HC/MF A02

Described is an application in which an Artificial Neural Network (ANN) controls the positioning of a robot arm with five degrees of freedom by using visual feedback provided by two cameras. This application and the specific ANN model, local liner maps, are based on the work of Ritter, Martinetz, and Schulten. We extended their approach by generating a filtered, average positioning error from the continuous camera feedback and by coupling the learning rate to this error. When the network learns to position the arm, the positioning error decreases and so does the learning rate until the system stabilizes at a minimum error and learning rate. This abolishes the need for a predetermined cooling schedule. The automatic cooling procedure results in a closed loop control with no distinction between a learning phase and a production phase. If the positioning error suddenly starts to increase due to an internal failure such as a broken joint, or an environmental change such as a camera moving, the learning rate increases accordingly. Thus, learning is automatically activated and the network adapts to the new condition after which the error decreases again and learning is 'shut off'. The automatic cooling is therefore a prerequisite for the autonomy and the fault tolerance of the system. Author

N92-26095*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ITERATIVE REPAIR FOR SCHEDULING AND RESCHEDULING
Monte Zweben, Eugene Davis, and Michael Deale (Lockheed Space Operations Co., Washington, DC.) Sep. 1991 22 p
(NASA-TM-107871; NASA-FIA-91-16; NAS 1.15:107871) Avail: NTIS HC/MF A03

An iterative repair search method is described called constraint based simulated annealing. Simulated annealing is a hill climbing search technique capable of escaping local minima. The utility of the constraint based framework is shown by comparing search performance with and without the constraint framework on a suite of randomly generated problems. Results are also shown of applying the technique to the NASA Space Shuttle ground processing problem. These experiments show that the search methods scales to complex, real world problems and reflects interesting anytime behavior. Author

N92-26097*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MYTHS AND LEGENDS IN LEARNING CLASSIFICATION RULES
Wray Buntine (Research Inst. for Advanced Computer Science, Moffett Field, CA.) May 1990 10 p Submitted for publication
(NASA-TM-107893; NASA-RIA-90-05-08-1; NAS 1.15:107893)
Avail: NTIS HC/MF A02

A discussion is presented of machine learning theory on empirically learning classification rules. Six myths are proposed in the machine learning community that address issues of bias, learning as search, computational learning theory, Occam's razor, universal learning algorithms, and interactive learning. Some of the problems raised are also addressed from a Bayesian perspective. Questions are suggested that machine learning researchers should be addressing both theoretically and experimentally. Author

N92-26098*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANALYTICAL LEARNING AND TERM-REWRITING SYSTEMS
Philip Laird and Evan Gamble Jun. 1990 48 p
(NASA-TM-107892; NASA-FIA-90-06-17-7; NAS 1.15:107892)
Avail: NTIS HC/MF A03

Analytical learning is a set of machine learning techniques for revising the representation of a theory based on a small set of examples of that theory. When the representation of the theory is correct and complete but perhaps inefficient, an important objective of such analysis is to improve the computational efficiency of the representation. Several algorithms with this purpose have been suggested, most of which are closely tied to a first order logical language and are variants of goal regression, such as the familiar explanation based generalization (EBG) procedure. But because predicate calculus is a poor representation for some domains, these learning algorithms are extended to apply to other computational models. It is shown that the goal regression technique applies to a large family of programming languages, all based on a kind of term rewriting system. Included in this family are three language families of importance to artificial intelligence: logic programming, such as Prolog; lambda calculus, such as LISP; and combinatorial based languages, such as FP. A new analytical learning algorithm, AL-2, is exhibited that learns from success but is otherwise quite different from EBG. These results suggest that term rewriting systems are a good framework for analytical learning research in general, and that further research should be directed toward developing new techniques. Author

N92-26099*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
IN DEFENSE OF COMPILATION: A RESPONSE TO DAVIS' FORM AND CONTENT IN MODEL-BASED REASONING
Richard Keller (Sterling Federal Systems, Inc., Moffett Field, CA.) May 1990 20 p Submitted for publication
(Contract NAS2-11555)
(NASA-TM-107891; NASA-FIA-90-06-25-01; NAS 1.15:107891)
Avail: NTIS HC/MF A03

In a recent paper entitled 'Form and Content in Model Based Reasoning', Randy Davis argues that model based reasoning research aimed at compiling task specific rules from underlying device models is mislabeled, misguided, and diversionary. Some of Davis' claims are examined and his basic conclusions are challenged about the value of compilation research to the model based reasoning community. In particular, Davis' claim is refuted that model based reasoning is exempt from the efficiency benefits provided by knowledge compilation techniques. In addition, several misconceptions are clarified about the role of representational form in compilation. It is concluded that techniques have the potential to make a substantial contribution to solving tractability problems in model based reasoning. Author

N92-26100*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PARADIGMS FOR MACHINE LEARNING
Jeffrey C. Schlimmer (Carnegie-Mellon Univ., Pittsburgh, PA.) and Pat Langley 15 Apr. 1991 44 p Submitted for publication
(NASA-TM-107864; NASA-FIA-91-10; NAS 1.15:107864) Avail: NTIS HC/MF A03

Five paradigms are described for machine learning: connectionist (neural network) methods, genetic algorithms and classifier systems, empirical methods for inducing rules and decision trees, analytic learning methods, and case-based approaches. Some dimensions are considered along with these paradigms vary in their approach to learning, and the basic methods are reviewed that are used within each framework, together with open research issues. It is argued that the similarities among the paradigms are more important than their differences, and that future work should attempt to bridge the existing boundaries. Finally, some recent developments in the field of machine learning are discussed, and their impact on both research and applications is examined. Author

N92-26118*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LEARNING CLASSIFICATION TREES
Wray Buntine (Research Inst. for Advanced Computer Science, Moffett Field, CA.) 19 Feb. 1991 20 p Presented at the Third International Workshop on Artificial Intelligence and Statistics, Fort Lauderdale, FL, 3-5 Jan. 1991
(NASA-TM-107883; NASA-FIA-90-12-19-01; NAS 1.15:107883) Avail: NTIS HC/MF A03

Algorithms for learning classification trees have had successes in artificial intelligence and statistics over many years. How a tree learning algorithm can be derived from Bayesian decision theory is outlined. This introduces Bayesian techniques for splitting, smoothing, and tree averaging. The splitting rule turns out to be similar to Quinlan's information gain splitting rule, while smoothing and averaging replace pruning. Comparative experiments with reimplementations of a minimum encoding approach, Quinlan's C4 and Breiman et al. Cart show the full Bayesian algorithm is consistently as good, or more accurate than these other approaches though at a computational price. Author

N92-26143*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
KINEMATICS OF AN IN-PARALLEL ACTUATED MANIPULATOR BASED ON THE STEWART PLATFORM MECHANISM
Robert L. Williams, II Mar. 1992 54 p
(NASA-TM-107585; NAS 1.15:107585) Avail: NTIS HC/MF A04

This paper presents kinematic equations and solutions for an in-parallel actuated robotic mechanism based on Stewart's platform. These equations are required for inverse position and resolved rate (inverse velocity) platform control. NASA LaRC has a Vehicle Emulator System (VES) platform designed by MIT which is based on Stewart's platform. The inverse position solution is straight-forward and computationally inexpensive. Given the desired position and orientation of the moving platform with respect to the base, the lengths of the prismatic leg actuators are calculated. The forward position solution is more complicated and theoretically has 16 solutions. The position and orientation of the moving platform with respect to the base is calculated given the leg actuator lengths. Two methods are pursued in this paper to solve this problem. The resolved rate (inverse velocity) solution is derived. Given the desired Cartesian velocity of the end-effector, the required leg actuator rates are calculated. The Newton-Raphson Jacobian matrix resulting from the second forward position kinematics solution is a modified inverse Jacobian matrix. Examples and simulations are given for the VES. Author

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-25153# Oak Ridge National Lab., TN.
MESON SPECTRA FROM 2-BODY DIRAC EQUATIONS WITH MINIMAL INTERACTIONS
H. W. Crater (Tennessee Univ., Tullahoma.), P. VanAlstine, R. L. Becker, and C. Y. Wong 1991 5 p Presented at the 4th International Conference on Hadron Spectroscopy, College Park, MD, 12-16 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE92-008893; CONF-910864-12) Avail: NTIS HC/MF A01

Many authors have used two-body relativistic wave equations with spin in nonperturbative numerical quark model calculations of the meson spectrum. Usually, they adopt a truncation of the Bethe-Salpeter equation of QED and/or scalar. QED and replace the static Coulomb interactions of those field theories with a semiphenomenological Q(bar Q) potential whose insertion in the Breit terms give the corresponding spin corrections. However, the successes of these wave equations in QED have invariably depended on perturbative treatment of the terms in each beyond the Coulomb terms. There have been no successful nonperturbative numerical test of two-body quantum wave equations in QED, because in most equations the effective potentials beyond the Coulomb are singular and can only be treated perturbatively. This is a glaring omission that we rectify here for the case of the two-body Dirac equations of constraint dynamics. We show in this paper that a nonperturbative numerical treatment of these equations for QED yields the same spectral results as a perturbative treatment of them which in turn agrees with the standard spectral results for positronium and muonium. This establishes that the vector and scalar interaction structures of our equations accurately incorporate field theoretic interactions in a bone fide relativistic wave equation. The last portion of this work will report recent quark model calculations using these equations with the Adler-Piran static Q(bar Q) potential. DOE

N92-25252# International Centre for Theoretical Physics, Trieste (Italy).
SOME PARTICULAR SOLUTIONS OF THE N-BODY PROBLEM ON THE LINE, OBTAINED FROM SUPERSYMMETRY
A. Gonzalez and R. Gonzalez (Instituto de Cibernetica, Matematica y Fisica, Havanna, Cuba) Aug. 1991 7 p
(DE92-615258; IC-91/243) Avail: NTIS HC/MF A02

Supersymmetry is used in order to construct a class of N-body bosonic Hamiltonians in one spatial dimension, for which the ground state energy and wave function can be explicitly written. The corresponding interaction among particles is described by N-body, nonsingular potentials. DOE

N92-25292 Politecnico di Milano (Italy). Dipartimento di Elettronica.
ON THE UNCERTAINTY OF STRAIGHT LINES IN DIGITAL IMAGES
Vincenzo Caglioti Feb. 1992 32 p Sponsored in part by CNR
(Rept-92-003; ETN-92-91363) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A new model is proposed for the evaluation of the uncertainty in the parameters of straight lines, as extracted from digital images, which accounts both for image discretization and for lateral dispersion of the line points around the line. Some results concerning uncertainty are derived for the pure discretized model. An iterative method for the estimation of the line parameters according to the proposed model is illustrated, and compared with the least squares method with respect to two aspects: the line parameters estimate and the estimate of their covariance matrix. It comes out that, although the difference in the parameters estimates is neglectable, the covariance matrix estimates often differ significantly: the least squares method almost systematically underestimates the uncertainty on the line parameters. ESA

N92-25293 Politecnico di Milano (Italy). Artificial Intelligence and Robotics Projects.
THE PLANAR THREE-LINES JUNCTION PERSPECTIVE PROBLEM WITH APPLICATION TO THE RECOGNITION OF POLYGONAL PATTERNS
Vincenzo Caglioti Jan. 1992 14 p
(Rept-92-004; ETN-92-91364) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A planar pattern called three lines junction is considered and a method is presented for its localization. This method can be used to recognize polygonal patterns of maximum complexity from single images perspective views. This method, which reduces to the solution of a two degree equation, was compared with other localization methods (such as triangle localization methods) useful to recognize minimally complex planar patterns from the analytic point of view. Moreover, this method was compared with equally simple methods working on approximate perspectives, with respect to the recognition precision. ESA

N92-25317# International Centre for Theoretical Physics, Trieste (Italy).
TRISECANT CURVES TO A SMOOTH CURVE IN P3 OF DEGREE d LESS THAN 3g + 3
F. Laytimi Oct. 1991 8 p In FRENCH
(DE92-619253; IC-91/343) Avail: NTIS HC/MF A02

It is demonstrated that if C is a smooth curve of degree d greater than 3g + 3 in P(sub 3), the curve T of trisecants to C considered immerged in the variety C(sub 3) of divisors of 3 degrees in C is connected. DOE

N92-25334# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
STABLE EQUIVALENCE OF THE WEAK CLOSURES OF FREE GROUPS CONVOLUTION ALGEBRAS
F. Radulescu Dec. 1991 31 p
(PB92-149467; IHES/M/91/90) Avail: NTIS HC/MF A03

It is shown that the algebras L(F sub N) = C(F sub N) bar(sup omega), the weak closures of the group algebras associated to free (nonabelian) groups F sub N,N = or greater than 2, N finite, are all stable isomorphic, i.e., that the isomorphism class of L(F sub N) (tensor product) B(H), doesn't depend on N (epsilon) N,N = or greater than 2. (Here B(H) is the algebra of bounded operators on an infinite dimensional, separable, Hilbert space H). Author

N92-25355# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
KNOWLEDGE GRAPH OF KNOWLEDGE REPRESENTATION THEORY
H. vandenBerg and C. Hoede Jun. 1991 28 p
(PB92-148584; MEMO-980) Avail: NTIS HC/MF A03

The process of knowledge acquisition can be divided into different stages. In the first stage, the knowledge engineer has to define, organize, and structure the knowledge domain. Not many tools are around to facilitate this stage of the knowledge acquisition procedure. The Knowledge Integration and Structuring System (KISS) is such a tool. It structures knowledge in texts, resulting in a model of that knowledge. In the paper KISS is described. As an example, KISS is applied to a test about knowledge representation theory, resulting in a model of knowledge representation theory. This model is used to compare the knowledge representation formalism of Knowledge Graphs with other representation formalisms. GRA

N92-25364# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
ASYMPTOTIC INVARIANTS OF INFINITE GROUPS
M. Gromov Feb. 1992 197 p
(PB92-153261; IHES/M/92/8) Avail: NTIS HC/MF A09

The efficiency of the geometric language for defining invariants and isolating interesting properties of groups is demonstrated. In many cases, it just specializes the standard notions of the asymptotic geometry to groups in order to make them known to the group theorists. It does not attempt a serious study of the invariants and leaves the standard questions wide open. On some occasions, it treats simple examples lying immediately on the surface. Often it speculates on the possible outcome of the game only not to lose the reader's attention, even when it has no inkling of a viable approach to the solution. GRA

N92-25375# RAND Corp., Santa Monica, CA.
A BIAS BOUND FOR LEAST SQUARES LINEAR REGRESSION
Naihua Duan and Ker-Chau Li (California Univ., Los Angeles.) 1991 12 p Repr. from Statistica Sinica, v. 1, no. 1, Jan. 1991 p 127-136 Sponsored in part by Societal Inst. of the Mathematical Sciences and EPA
(Grant NSF DMS-86-02018)
(RAND/N-3417-SIMS/RC) Avail: NTIS HC/MF A03

Consider a general linear model y = g(alpha + beta(x)) + epsilon, where the link function g is arbitrary and unknown. The maximal component of (alpha,beta) that can be identified is the direction of beta, which measures the substitutibility of the components of x. If zeta(beta(x)) = e(x:beta(x)) is linear in beta(x), the least squares linear regression of y on x gives a consistent estimate for the direction of beta, despite possible nonlinearity in the link function. If zeta(beta(x)) is nonlinear, the linear regression might be inconsistent for the direction of beta. We establish a bound for the asymptotic bias, which is determined from the nonlinearity in zeta(beta(x)), and the multiple correlation coefficient R(exp 2) for the least squares linear regression of x on y. According to the bias bound, the linear regression is nearly consistent for the direction of beta, despite possible nonlinearity in the link function, provided that the nonlinearity in the zeta(beta(x)) is small compared to R(exp 2). Our measure of nonlinearity in zeta(beta(x)) is analogous to the maximal curvature. The bias bound is tight; we give the construction for the least favorable models which achieve the bias bound. The theory is applied to a special case for illustration. Author

N92-25388# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
BAECKLUND TRANSFORMATIONS IN BILINEAR FORM FOR SOLITON HIERARCHIES
G. F. Post and G. F. Helminck Jun. 1991 19 p
(PB92-148592; MEMO-981) Avail: NTIS HC/MF A03

The authors discuss how, in a unified way, one can find Backlund transformations in bilinear form for reductions of the Kadomtsev-Petiashvili (KP) and BKP hierarchy. Moreover, generically, they determine the solution of the Backlund transformation. Author

N92-25389# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
GREEDY k-COVERINGS OF INTERVAL ORDERS
U. Faigle and W. M. Nawijn Jun. 1991 16 p
(PB92-148576; MEMO-979) Avail: NTIS HC/MF A03

A last-fit greedy algorithm is presented that computes a maximal subset of an interval order subject to being describable by k chains. The algorithm runs in time O(n logn) if an explicit interval representation is known. A pre-processing algorithm of running time O(n(sup2)) decides whether the transitive closure of a given acyclic diagraph is n interval order. As an application of the greedy k-covering, the optimality of a simple on-line algorithm is provided that minimizes the number of jobs lost when processed on k identical machines. Author

N92-25390# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
CLIQUE POLYNOMIALS AND INDEPENDENT SET POLYNOMIALS OF GRAPHS
C. Hoede and L. Xueliang Jul. 1991 18 p
(PB92-148600; MEMO-982) Avail: NTIS HC/MF A03

The paper introduces two kinds of graph polynomials, the clique polynomial and the independent set polynomial. The paper focuses on expansions of these polynomials. Some open problems are mentioned. Author

N92-25429 Politecnico di Milano (Italy). Dipartimento di Elettronica.
CHARACTERIZATION OF THE FACE OF THE MINIMUM COST SPANNING TREE PROBLEM AND EXTENSIONS
Horst W. Hamacher, Francesco Maffioli, and Katta G. Murty (Michigan Univ., Ann Arbor.) 1991 11 p Sponsored in part by Italian Ministry of University and Scientific and Technological Research
(Grant NATO-RG-85-02407)
(Rept-91-037; ETN-92-91248) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The characterization of the set of all minimum cost spanning trees in a connected undirected network G, where G = (N, A, C) with N = the set of nodes, A = the set of edges and C = the vector of edge cost coefficients, is presented. Proofs and theorems relating to the convex hull of minimum cost spanning tree incidence vectors, second best valued spanning tree, and matroid extensions are given. ESA

N92-25457# Westfaelische Wilhelms Univ., Muenster (Germany, F.R.).
SOLUTION DIFFERENTIABILITY FOR NONLINEAR PARAMETRIC CONTROL PROBLEMS
Helmut Maurer and Hans Josef Pesch (Technische Univ., Munich, Germany, F.R.) 1991 25 p
(Rept-316) Avail: NTIS HC/MF A03

We consider perturbed nonlinear control problems with data depending on a vector parameter. Using second order sufficient optimality conditions, it is shown that the optimal solution and the adjoint multipliers are differentiable functions of the parameter. The proof of this second order sensitivity result exploits the close connections between solutions of a Riccati differential equation, the non-conjugate point condition and shooting methods for solving the associated boundary value problem. The solution differentiability provides a firm theoretical basis for numerical feedback schemes which have been developed for computing neighboring extremals. Author

N92-25501# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
LECTURES ON ITERATIVE METHODS: THE SUBLINEAR CASE
O. Nevanlinna May 1991 49 p
(PB92-141787; ISBN-951-22-0644-7; Rept-C8) Avail: NTIS HC/MF A03

The aim is to explain the behavior of Generalized Minimum Residual Scheme (GMRES)-type acceleration procedures in large dimensional nonsymmetric problems, carrying out a discussion in terms of the spectrum of the iteration operator on three levels corresponding to linear, sublinear, and superlinear convergence. Here, the author studies the basic iteration and the polynomial acceleration methods for fixed point problems (1) x = Lx + g under the assumptions that L is a bounded operator in a Banach space X and that g is such that (1) has a solution: g (epsilon) (1 - L)X. The main motivation is not to study nearly singular problems which do not blow up together with the condition number of 1 - L. This will typically lead to sublinear convergence estimates. Author

N92-25521# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
KLEIN'S COMBINATION THEOREM 4
B. Maskit Feb. 1992 39 p
(Grant NSF DMS-90-03361)
(PB92-153238; IHES/M/92/5) Avail: NTIS HC/MF A03

An expansion is presented of the combination theorems to cover the following problems. New rank 1 parabolic subgroups are produced, while all elliptic and parabolic elements are tracked. A proof is given that the combined group is analytically finite if and only if the original groups are; in the analytically finite case, it also gives a formula for the hyperbolic area of the combined group (i.e., the hyperbolic area of the set of discontinuity on the 2-sphere modulo G) in terms of the hyperbolic areas of the original groups. There is also a new variation on the first combination theorem in which the common subgroup has finite index in one of the two groups. Author

N92-25543# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
EXPLICIT MATRICES FOR FUCHSIAN GROUPS
B. Masket Feb. 1992 14 p
(Grant NSF DMS-90-03361)
(PB92-153220; IHES/M/92/6) Avail: NTIS HC/MF A03

Explicit matrix generators, a1, b1, a2, b2, are written down for Fuchsian groups representing closed Riemann surfaces of genus 2, where the entries in these matrices are polynomials in certain parameters. The space of parameters is explicitly described by simple inequalities. However, these matrices will generally not have unit determinant, but will lie in PGL+(2,R) (+ denotes a class of matrices of positive determinant). The Fuchsian groups will all be normalized. Also presented is a related procedure for arbitrary genus. That is, given greater than or = 2, a procedure is described for writing down an explicit parameter space, and matrices, a1, b1, ..., ag, bg, where these matrices all have positive determinant; the entries are algebraic rather than polynomial (however, for g = 2, they are also polynomial) functions of the parameters. The result for genus 2 has the following consequence. There are matrices a1, b1, a2, b2, each with positive determinant and integer entries, so that these are a canonical set of generators for a Fuchsian group of genus 2. Author

N92-25709# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
C2 INTERPOLATION SUBDIVISION SCHEME FOR CURVES
R. vanDamme Aug. 1991 10 p
(PB92-148642; MEMO-986) Avail: NTIS HC/MF A02

A one parameter, 4-point interpolatory subdivision scheme is considered in which at each recursion step two points are inserted between two old ones. Sharp conditions are derived for the free parameter for which the curve is guaranteed to be C(sup 2). The algorithm proposed here, is very suitable for Hermite interpolation. GRA

N92-25730* University of Southern California, Los Angeles. Center for Applied Mathematical Sciences.
HOMOGENIZATION TECHNIQUES AND ESTIMATION OF MATERIAL PARAMETERS IN DISTRIBUTED STRUCTURES
H. T. Banks, D. Cioranescu, A. Das, R. Miller, and D. A. Rebnord (Syracuse Univ., NY.) May 1991 2 p
(Grants NAG1-1116; AF-AFOSR-0091-90; NSF DMS-88-18530)
(NASA-CR-190329; NAS 1.26:190329) Avail: Issuing Activity

The use is discussed of homogenization techniques to derive approximate models with simple geometry for physical models of grids and trusses which have a complex geometry that gives rise to computational difficulties. The context of inverse or parameter estimation problems for composite material structures with unknown characteristics such as stiffness and internal damping. The necessary theoretical foundations are presented for this approach and comparison is discussed of modal properties of the resulting homogenization model for a two dimensional grid structure with modal properties observed in experiments with this grid. Author

N92-25749# Lawrence Livermore National Lab., CA.
STABILITY OF LATTICE BOLTZMANN METHODS
B. Elton, C. D. Levermore, and G. Rodrigue (California Univ., Davis.) Aug. 1991 6 p Presented at the 4th International Symposium on Computational Fluid Dynamics, Davis, CA, 9-12 Sep. 1991
(Contract W-7405-eng-48)
(DE92-009124; UCRL-JC-108179; CONF-9109257-2) Avail: NTIS HC/MF A02

In this paper, a stability condition is established that will guarantee the convergence of the solution of a partial differential equation to the solution of a lattice Boltzmann method. The partial differential equation is determined by consistency conditions on a Chapman-Enskog/Hilbert asymptotic expansion. DOE

N92-25968# Florida Univ., Gainesville. Inst. for Fundamental Theory.
CONSTRUCTION OF LAX OPERATORS FROM WEIGHT DIAGRAMS
S. L. Carbon and E. J. Piard May 1991 13 p
(Contract DE-FG05-86ER-40272)
(DE92-008773; DOE/ER-40272/130; UFIFT-HEP-91-11) Avail: NTIS HC/MF A03

We show that cyclic weight diagrams corresponding to representations of affine Lie algebras allow one to read-off the associated Lax operator. The resultant Lax pair generates the modified KdV equations, and was shown in some cases to produce acceptable solutions of the string equation of matrix models. DOE

N92-25969# Florida Univ., Gainesville. Inst. for Fundamental Theory.
METAPLECTIONS AND FRACTIONAL STATISTICS
D. J. Castano 1991 18 p
(Contract DE-FG05-86ER-40272)
(DE92-008776; DOE/ER-40272/132; UFIFT-HEP-91-13) Avail: NTIS HC/MF A03

The spinor representations of the orthosymplectic Lie supergroup, OSp(r/2m,R), are used as a means to induce new fractional statistics in certain (2 + 1)-dimensional models. Theories of objects with arbitrary spin and statistics known as anyons are possible in (2 + 1)-dimensions. DOE

N92-25971# Florida Univ., Gainesville. Inst. for Fundamental Theory.
WEIGHT DIAGRAM CONSTRUCTION OF LAX OPERATORS
S. L. Carbon and E. J. Piard Oct. 1991 38 p
(Contract DE-FG05-86ER-40272)
(DE92-008781; DOE/ER-40272/140; UFIFT-HEP-91-27) Avail: NTIS HC/MF A03

We review and expand the methods introduced in our previous paper. It is shown that cyclic weight diagrams corresponding to representations of affine Lie algebras allow one to construct the associated Lax operator. The resultant Lax operator is in the Miura-like form and generates the modified KdV equations. The algorithm is extended to the super-symmetric case. DOE

N92-25986# International Centre for Theoretical Physics, Trieste (Italy).
A TWO-PARAMETRIC SOLUTION TO GRADED YANG-BAXTER EQUATION AND TWO-PARAMETRIC DEFORMED ALGEBRA U(SUB qq)gl(1/1)
Hong Yan, Yan Zhou, and Tian-Hua Zhu (Columbia Univ., New York, NY.) Sep. 1991 14 p
(DE92-616922; IC-91/295) Avail: NTIS HC/MF A03

We give a two-parametric solution of graded Yang-Baxter equation (YBE) and perform the Yang-Baxterization to obtain the solution of quantum YBE. Using a formalism that was developed in earlier works, we give the two-parametric quantized superalgebra U(sub qq)gl(1/1). DOE

N92-26112# Nova Univ., Dania, FL. Oceanographic Center.
NON-ITERATIVE GEOMETRIC APPROACH TO NONLINEAR PARAMETRIC LEAST-SQUARES ADJUSTMENT WITH OR WITHOUT CONSTRAINTS Final Technical Report, 4 Apr. 1989 - 3 May 1991
Georges Blaha Apr. 1991 65 p
(Contract F19628-89-K-0016; AF Proj. 61102F; AF Proj. 2309G1BY)
(PL-TR-91-2136) Avail: NTIS HC/MF A04

A nonlinear parametric adjustment model with n observations and u parameters can be interpreted geometrically as the description of a u dimensional 'model surface' embedded in an n dimensional flat 'observational space'. Two geometric concepts were identified for the least squares resolution of this model. The first concept is linked to the Gauss form of the surface, which is the most direct representation of the parametric model; however, the solution is iterative in nature. The second concept is linked to the functional form of the surface, and it leads to a noniterative solution. The Gauss form of the surface is presented and can be transformed into the functional form of the surface. Both concepts make use of the Taylor series expansion containing the first and higher order partial derivatives of the observables with respect to the parameters. Author

N92-26145# Louisiana State Univ., Baton Rouge. Dept. of Mathematics.
PARTIAL SUPPORT FOR THE 22ND SOUTHEASTERN INTERNATIONAL CONFERENCE ON COMBINATORICS, GRAPH THEORY AND COMPUTING Final Report, 1 Oct. 1990 - 30 Sep. 1991
James G. Oxley 30 Sep. 1991 2 p Conference held in Baton Rouge, LA, 11-18 Feb. 1991
(Contract N00014-91-J-1018)
(AD-A245674) Avail: NTIS HC/MF A01

The Twenty-Second Southeastern International Conference on Combinatorics, Graph Theory and Computing featured eight instructional lectures by five principal speakers: William R. Pulleyblank of IBM Thomas J. Watson Research center spoke on 'Disc Representations of Planar Graphs and their Duals' and 'Exact Optimization Problems'; Robin Thomas Georgia Institute of Technology spoke on 'Recent Results in the Theory of Graphs Minors'; Richard A. Brualdi of the University of Wisconsin spoke on 'Graphs and Matrices' and 'Matrices and Graphs'; Paul Erdos of the Hungarian Academy of Sciences spoke on'Combinatorial Problems in Geometry'; and Chris Godsil of the University of Waterloo spoke on 'Linear Algebra and Combinatorics'; and 'Polynomial Spaces'. At four parallel sessions, a total of two hundred and six fifteen-minute contributed papers were presented. The conference was attended by three hundred and four mathematicians and computer scientists from across the United States, Canada, and overseas. The conference proceedings are being published by Congressus Numerantium. These proceedings occupy five volumes of this journal and a copy will be mailed to the three places that receive this report when the proceedings are published early in 1992. GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-26037# Naval Postgraduate School, Monterey, CA.
SECOND ORDER APPROXIMATION FOR VARIANCE OF SEP M.S. Thesis
Arthur F. Brock Sep. 1991 99 p
(AD-A245809) Avail: NTIS HC/MF A05

A method for the computation of confidence intervals for circular error probability (CEP) based on first order variance estimates was introduced in 1966. It was later found that under certain conditions the resulting confidence intervals for CEP were smaller than expected. As a result a second order variance estimate method was developed, at the Johns Hopkins University Applied Physics Laboratory, which greatly improved the accuracy of the confidence intervals for CEP. The purpose of this thesis is to develop and test procedures for the 3-dimensional case to obtain a second order estimate for variance of spherical error probability (SEP). GRA

N92-26082# Naval Postgraduate School, Monterey, CA.
A COMPARISON OF 3 NUMERICAL METHODS FOR UPDATING REGRESSIONS M.S. Thesis
Grigorios J. Raptis Sep. 1991 95 p
(AD-A245883) Avail: NTIS HC/MF A05

Three numerical procedures are presented for updating regressions. All three methods are based on QR factorization, but after that they use different philosophies to update the regression coefficients. Elden's algorithm updates using only the triangular matrix R. This procedure does not use orthogonal transformations, but it uses hyperbolic rotations. The modified Gram-Schmidt QR

process is used by Gragg-Leveque-Trangenstein's method where the matrix with orthonormal columns is stored and updated. Chan's algorithm computes a column permutation 2 and a QR factorization of a matrix A such that a rank deficiency of A will be revealed. Although the three methods are based on different ideas and can be used for different purposes their comparison shows that Chan's algorithm is the only accurate one in the rank deficient case, and that Gragg-Leveque-Trangenstein's method is the cheapest and the most stable. GRA

N92-26152# Naval Postgraduate School, Monterey, CA.
THE SHORTEST PATH PROBLEM IN THE PLANE WITH OBSTACLES: BOUNDS ON PATH LENGTHS AND SHORTEST PATHS WITHIN HOMOTOPY CLASSES M.S. Thesis
Andre M. Cuerington Jun. 1991 118 p
(AD-A245738) Avail: NTIS HC/MF A06

The problem of finding the shortest path between two points in the plane containing obstacles is considered. The set of such paths is uncountably infinite, making an exhaustive search impossible. This difficulty is overcome by reducing the size of the search space. The search is first restricted to a countably infinite set by focusing attention on the set of homotopy classes. By applying simple optimality principles, we obtain a finite list of such classes whose union contains the shortest path. This process of simplification is discussed in the thesis of Capt Kevin D. Jenkins, U.S. Marine Corps. In this thesis we first discuss a computational investigation of two methods by which homotopy classes can be named. Next, a computational heuristic is presented that finds the lower bound for a path in a class. Finally, the true shortest path is found by searching these classes in order of increasing lower bound. One application of this study is in the area of robotic path planning. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-25426 Physics and Electronics Lab. TNO, The Hague (Netherlands).
EVALUATION AND ANALYSIS OF SIMULATION RESULTS Interim Report [WAARDERING EN ANALYSE VAN SIMULATIERESULTATEN]
M. vanderKaaij and J. K. Vink Dec. 1991 70 p In DUTCH; ENGLISH summary
(Contract A89KL619)
(FEL-91-A323; TD91-3696; ETN-92-91219) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

Questions concerning the deployment of weapon systems using the stochastic combat simulation model FSM (Force Structure Model) and statistical techniques are addressed. The results of combat simulations can be evaluated with the help of one or more measure of effectiveness. When using a stochastic model, the model has to be run several times with the same input. In this way a set of observations is generated and something can be said about the distribution of possible outcomes. Statistical tests are described with which two sets of observations can be compared to each other. Some computer programs for the analysis of simulation results are included together with some basic explanations. ESA

N92-25572 Michigan Univ., Ann Arbor.
ROBUST DESIGN OF STATE SPACE SYSTEMS WITH PARAMETRIC UNCERTAINTIES: A MULTIMODEL GUARANTEED COST APPROACH Ph.D. Thesis
Shuoh Rern 1991 285 p
Avail: Univ. Microfilms Order No. DA9208632

A variety of sufficient conditions are derived for (generalized) stability robustness of linear time invariant state-space systems with time-invariant parametric uncertainties. These bounds are based on the transformation of the stability robustness question into a nonsingularity question. Hence they do not guarantee quadratic stability and can be viewed as counter parts of Zhou-Khargonekar bounds. The exact computation of the largest robust stability radius is formulated as an unconstrained global minimization problem. Empirical evidence shows that 'simulated annealing' is a successful heuristic method to compute these radii. The above robust stabilization problem is reduced to the multimodel guaranteed cost problem by partitioning the domain of uncertainty and assigning to each subdomain a modified Lyapunov equation. This approach reduces the conservatism of the single modified algebraic Riccati equation approaches and avoids the difficulties of the simultaneous stabilization approach. The solution sets of these two problems are proven equal, providing the 'partitioning resolution' is finer than a threshold. One potential solution method for the multimodel guaranteed cost problem is explored. This method includes the construction and solution of an auxiliary minimization problem. If robust stabilizers exist and the initial guess is close enough to a solution of the auxiliary minimization problem, then primal-dual iteration is guaranteed to converge to it. Once a robust stabilizer is found, the optimal multimodel guaranteed cost problem can be solved, with it as an initial guess, by a modified Levine-Athans algorithm which is also derived. Dissert. Abstr.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-25945# International Centre for Theoretical Physics, Trieste (Italy).
GAUGE-INDEPENDENT GYRO-KINETIC EQUATION
C. Y. Chen and S. M. Mahajan Oct. 1991 11 p
(DE92-619514; IC-91/364) Avail: NTIS HC/MF A03

The present gyro-kinetic formalism is reinvestigated. To arrive at the gauge-independent gyro-kinetic equation, we start with the standard linearized Vlasov equation in terms of the gyro-kinetic variables and deal with all terms in the equation consistently in the gyro-average process. The obtained solution is explicitly gauge-independent and the physical meaning of all the terms in the solution is independently manifested. Finally, to show application of the theory, we discuss the drift mode with the achieved formalism. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-25207# Lawrence Livermore National Lab., CA.
A MAGNETOOPTIC IMAGING PROBE FOR CONTINUOUS MAGNETIC FIELD PROFILES
G. Dimonte Mar. 1992 12 p Presented at the 9th Topical Conference on High-Temperature Plasma Diagnostics, Santa Fe, NM, 15-19 Mar. 1992
(Contract W-7405-eng-48)
(DE92-008942; UCRL-JC-109218; CONF-920362-1) Avail: NTIS HC/MF A03

Magnetic field profiles are measured continuously in space and time using Faraday rotation in magnetooptic glass. A line focused laser beam which undergoes Faraday rotation within the glass element is imaged in one dimension through a polarizer and onto a streak camera. The system is described and used to characterize an exploding diamagnetic plasma cavity. DOE

N92-25344# Danish Space Research Inst., Lyngby.
THE EFFECT OF LARGE UNCOMPENSATED TRANSVERSE FIELDS ON THE FLUXGATE MAGNETIC SENSOR OUTPUT
F. Primdahl, H. Luhr, and E. Kring Lauridsen (Danish Meteorological

Inst., Copenhagen.) Jan. 1992 41 p
(ISSN-0109-6605) Avail: NTIS HC/MF A03

The effect of uncompensated transverse fields on the output of several types of fluxgate sensors has been investigated taking as a starting point the full 4pie steradian calibration model of the MAGSAT magnetometer, and proceeding with data from magnetometers in the laboratory and flown on board sounding rockets. Tubular ferrite core sensors are very sensitive to transverse fields. Ring-cores are sensitive to transverse fields but only in the plane of the ring. Linear double rod sensors are not affected by transverse fields. Maintaining the sensor in a homogeneous null field in all three directions eliminates the transverse field effect.
Author

N92-26026# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
CAM/LIFTER FORCES AND FRICTION
D. J. Gabbey, J. Lee, and D. J. Patterson Feb. 1992 84 p
(Contract DE-FG02-88CE-90025)
(DE92-011573; DOE/CE-90025/3) Avail: NTIS HC/MF A05

This report details the procedures used to measure the cam/lifter forces and friction. The present effort employed a Cummins LTA-10, and focuses on measurements and dynamic modeling of the injector train. The program was sponsored by the US Department of Energy in support of advanced diesel engine technology. The injector train was instrumented to record the instantaneous roller speed, roller pin friction torque, pushrod force, injector link force, and cam speed. These measurements, together with lift profiles for pushrod and injector link displacement, enabled the friction work loss in the injector train to be determined. Other significant design criteria such as camshaft roller follower slippage and maximum loads on components were also determined. Future efforts will concentrate on the dynamic model, with tests run as required for correlation. DOE

N92-26170# Lawrence Livermore National Lab., CA.
NUMERICAL SIMULATION OF COULOMBIC FREEZING
H. E. DeWitt, W. L. Slattery, and Juxing Yang (City Coll. of the City Univ. of New York, NY.) Feb. 1992 11 p Presented at the 6th Physics of Nonideal Plasmas Conference, Berlin (Germany, F. R.), 18-21 Nov. 1991
(Contracts W-7405-eng-48; W-7405-eng-36)
(DE92-009458; UCRL-JC-109726; CONF-9111198-1) Avail: NTIS HC/MF A03

The fluid to crystalline solid first order phase transition of the classical one component plasma (OCP) has been studied by Monte Carlo simulation in three dimensions for temperatures below the thermodynamic freezing temperature (gamma = zeta(exp 2)e(exp 2)/ak(tau) = 180, a = Wigner-Zeitz radius). With N = 686 we found freezing from a metastable supercooled fluid into microcrystals for values of (gamma) ranging from 250 to 700. In one case, gamma = 500, the system froze into a perfect bcc lattice from a random start. With more particles the system froze into two or more crystals one bcc and one fcc and smaller examples of hcp. The lattice planes were examined and various kinds of crystal defects could be observed. We developed a program for determining the local environment of each particle as bcc, fcc, hcp, or fluid in order to identify microcrystals in the system at any stage of the freezing process. Generally, freezing proceeds rapidly when any single microcrystal attains a sufficient size or roughly 60 to 70 particles. The observations of freezing seem to agree with classical nucleation theory. No separate glass phase (monocrystalline) was seen. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N92-25368*# Douglas Aircraft Co., Inc., Long Beach, CA.
INTERIOR NOISE PREDICTION METHODOLOGY: ATDAC THEORY AND VALIDATION
Gopal P. Mathur and Bryce K. Gardner Apr. 1992 48 p
(Contract NAS1-18037)
(NASA-CR-187626; NAS 1.26:187626) Avail: NTIS HC/MF A03

The Acoustical Theory for Design of Aircraft Cabins (ATDAC) is a computer program developed to predict interior noise levels inside aircraft and to evaluate the effects of different aircraft configurations on the aircraft acoustical environment. The primary motivation for development of this program is the special interior noise problems associated with advanced turboprop (ATP) aircraft where there is a tonal, low frequency noise problem. Prediction of interior noise levels requires knowledge of the energy sources, the transmission paths, and the relationship between the energy variable and the sound pressure level. The energy sources include engine noise, both airborne and structure-borne; turbulent boundary layer noise; and interior noise sources such as air conditioner noise and auxiliary power unit noise. Since propeller and engine noise prediction programs are widely available, they are not included in ATDAC. Airborne engine noise from any prediction or measurement may be input to this program. This report describes the theory and equations implemented in the ATDAC program.
Author

N92-25424 Physics and Electronics Lab. TNO, The Hague (Netherlands).
SONAR RANGE PREDICTION MODELS REPAS AND REACT Final Report [SONAR AFSTAND VOORSPELMODELLEN REPAS EN REACT]
P. Schippers Jul. 1991 44 p
(Contract A85KM060)
(FEL-90-A367; TD90-4520; ETN-92-91216) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

The range prediction models REPAS (range estimator for passive sonars) and REACT (RE for active sonars) and the propagation loss model ALMOST (acoustic loss model for operational studies and tasks) on which REPAS and REACT are based, are documented. The way in which the reverberation is calculated, which is an important part of the REACT model is described. A description of two modules, which calculate reverberation and target echo level as a function of time respectively is given. Afterwards time is converted to detection range for operational use. A method for the determination of the threshold level for various detection situations, used on REPAS as well as REACT, is included. With this method the detection probability can also be calculated versus detection range. Some examples of detection range prediction calculated by REPAS and REACT are presented. ESA

N92-25581 Rhode Island Univ., Kingston.
TURBULENT BOUNDARY LAYER DRIVEN ACOUSTIC RADIATION OF A SOLID BODY OF REVOLUTION Ph.D. Thesis
Pierre Joseph Corriveau 1991 310 p
Avail: Univ. Microfilms Order No. DA9202971

The flow induced radiated noise from a body of revolution was measured in a large acoustic tank. Two solid bodies were constructed without appendages to minimize structural reradiation and eliminate other flow noise sources. One body remained uncoated and the other was clad with an acoustic decoupler. The bodies were propelled at several initial velocities using a pneumatic launcher. A retrieval mechanism decelerated the bodies and returned them to a starting position. To maintain a vertical flight path, the vehicles traveled downward concentric with a guide wire. Direct radiation measurements were achieved by placing hydrophones near the flight path, but away from tank boundaries. Analog data were acquired on multiple runs, and at each initial velocity, using a multitrack tape recorder. The data were digitized into 10 msec record lengths then Fourier transformed into 25 KHz spectra. One-third octave bands were used for frequency averaging. Equations of motion were developed to determine body position at any point throughout the trajectory. Acoustic sources were observed at two locations on the body: at the nose and tail. Slant ranges to the hydrophones were computed, and the acoustic

source level was estimated at each source location for 1/3 octave bands from 1-20 KHz. Only data determined to be spherically spreading were ensemble averaged by class and within run. Nose and tail 1/3 OB source level spectra at each speed, including confidence intervals, were computed. A simple acoustic model adequately predicts the measured sound pressure. Present measurements are compared against two sets of published data. A nondimensional frequency is used to reconcile the tail radiation data sets. Present nose radiation appears higher than published data. Dissert. Abstr.

N92-26022# Naval Postgraduate School, Monterey, CA.
MULTIFREQUENCY ACOUSTIC RESONATORS WITH VARIABLE NONUNIFORMITY M.S. Thesis
Steven L. Alkov Jun. 1991 90 p
(AD-A245332) Avail: NTIS HC/MF A05

A new type of acoustic resonator utilizes alterations of the nonuniformity to achieve different resonance frequencies. Each resonator is designed to yield frequencies that correspond to musical notes. The apparatus are remarkably simple, employing piecewise uniform cross sectional areas that can easily and quickly be changed. The resonators are, thus, useful as educational demonstrations. The phenomenon can be understood physically and quantified perturbatively by the energy method of Rayleigh, or equivalently by the method of adiabatic invariance. Improved accuracy is obtained by matching one-dimensional solutions of the wave equation in the uniform regions. The agreement between this theory and the experimental data is less than one percent. Author (GRA)

N92-26033# Naval Postgraduate School, Monterey, CA.
COMPARATIVE ANALYSIS OF THE SAFARI MODEL WITH NATIVE 1 DATA IN THE VLF REGIME M.S. Thesis
Jerome L. Cleveland, Jr. Sep. 1991 120 p
(AD-A245347) Avail: NTIS HC/MF A06

Few underwater acoustic models have been validated in the very low frequency (VLF) regime. The purpose is to explore one model's abilities and compare it with ocean data once it is ascertained the model has converged to its final solution. A comparative analysis of data recorded in NATIVE 1 (the Noise and Transmission Loss in VLF Environments) Event 1 and results generated using the Seismic-Acoustic Fast field Algorithm for Range-Independent Environments (SAFARI) is the focus of this study, with emphasis on understanding some of the model's features. GRA

N92-26081# Naval Postgraduate School, Monterey, CA.
SOUND PROPAGATION IN THE INHOMOGENEOUS OCEAN M.S. Thesis
Daniel L. Devany Jun. 1991 61 p
(AD-A245879) Avail: NTIS HC/MF A04

By using a linear systems theory approach, an ocean medium transfer function based on the WKB approximation can be developed. The phase computations for the transfer function are made by evaluating the WKB phase integral. Two applications of ray acoustics theory are investigated as accurate, efficient alternatives to direct numerical integration of the WKB phase integral. Both applications base phase computations on signal travel time. The difference is their treatment of the sound-speed versus depth data pairs. One forms a sound-speed profile by using the piecewise linear approximation method while the other uses an Akima cubic spline fit to the data. Each method can identify source-to-receiver eigenrays and provide ray trace plots. GRA

N92-26130*# Wyle Labs., Inc., El Segundo, CA.
EVALUATION OF HUMAN RESPONSE TO STRUCTURAL VIBRATIONS INDUCED BY SONIC BOOMS
Louis C. Sutherland (Sutherland, Louis C., Rancho Palos Verdes, CA) and J. Czech May 1992 120 p Prepared for Douglas Aircraft Co., Inc., Long Beach, CA
(Contract NAS1-19060)
(NASA-CR-189584; NAS 1.26:189584; Wyle-WR-91-20) Avail: NTIS HC/MF A06

The topic is addressed of building vibration response to sonic boom and the evaluation of the associated human response to this vibration. An attempt is made to reexamine some of the issues addressed previously and to offer fresh insight that may assist in reassessing the potential impact of sonic boom over populated areas. Human response to vibration is reviewed first and a new human vibration response criterion curve is developed as a function of frequency. The difference between response to steady state versus impulsive vibration is addressed and a 'vibration exposure' or 'vibration energy' descriptor is suggested as one possible way to evaluate duration effects on response to transient vibration from sonic booms. New data on the acoustic signature of rattling objects are presented along with a review of existing data on the occurrence of rattle. Structural response to sonic boom is reviewed and a new descriptor, 'Acceleration Exposure Level' is suggested which can be easily determined from the Fourier Spectrum of a sonic boom. A preliminary assessment of potential impact from sonic booms is provided in terms of human response to vibration and detection of rattle based on a synthesis of the preceding material. Author

N92-26169# Louisiana State Univ., Baton Rouge. Dept. of Petroleum Engineering.
UNDERSTANDING THE EFFECT OF PORE PRESSURE ON ACOUSTIC VELOCITY MEASUREMENTS Final Report, Apr. 1990 - Apr. 1991
R. Desbrandes Nov. 1991 207 p
(Contract GRI-5087-215-1648)
(PB92-152925; GRI-92/0046) Avail: NTIS HC/MF A10

The initial objective was to determine the pore pressure in a cased hole using sonic waves. The project scope was later changed to encompass a general understanding of the effect of pore pressure on acoustic measurements. The acoustic parameters determined in sandstone intervals were to be correlated with the vertical stress, which, in turn, were to be related to the pore pressure, and the overburden stress. Results in the following areas were achieved: (1) interpretation of laboratory data available in the literature; (2) a depth tie-in technique; (3) downhole pore fluid and temperature data correction; (4) development of a stress determination method based on the slope of velocity curves; (5) development of a stress determination method based on velocity values; and (6) application of the methods to borehole data from three wells. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-25152# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
SPECTROSCOPY AND REACTION DYNAMICS OF COLLISION COMPLEXES CONTAINING HYDROXYL RADICALS
M. I. Lester Feb. 1992 5 p
(Contract DE-FG02-87ER-13792)
(DE92-008743; DOE/ER-13792/5) Avail: NTIS HC/MF A01

The intermolecular bending and stretching vibrations supported by the OH X (exp 2)(Pi) + Ar (exp 1)S(sub 0) potential energy surfaces have been accessed by stimulated emission pumping (SEP) of the weakly bound OH-Ar X (exp 2)(Pi) complex. Virtually all of the bound vibrational levels of the complex, from the zero-point level to the dissociation limit, have been identified. OH-Ar complexes prepared in these levels undergo predissociation by using OH rotational or spin-orbit excitation to break the weak OH-Ar intermolecular bond. Perturbation theory calculations have been carried out to understand the physical origin of the dynamical processes occurring on the OH X (exp 2)(Pi) + Ar (exp 1)S(sub 0) potential energy surfaces. DOE

N92-25158# Colorado State Univ., Fort Collins. Dept. of Physics.
PROPERTIES OF MOLECULAR SOLIDS AND FLUIDS AT HIGH PRESSURE AND TEMPERATURES
R. D. Etters Mar. 1992 15 p
(Contract DE-FG02-86ER-45238)
(DE92-009989; DOE/ER-45238/8) Avail: NTIS HC/MF A03

This renewal request for DOE grant DE-FG02-86ER-45238, is dedicated to providing a complete thermodynamic profile of solids fluids, and fluid mixtures, over a wide range of temperatures and pressures. We are partially motivated by technological interest in detonation, combustion, superhard high pressure materials, and high temperature superconductors, which are important components of interest of various DOE laboratories. Our work on fluids and solids, composed of simple molecules, involves the determination of structures, phase transitions, pressure-volume relations, phonon, vibron, and libron modes of excitation, sound velocities, specific heats, thermal expansion, virial coefficients, sublimation energies, and orientational translational, and magnetic correlations. We hope that the study of these systems under extreme thermodynamic conditions will lead to exotic new materials of value, as well as enhanced fundamental understanding. DOE

N92-25273# Fermi National Accelerator Lab., Batavia, IL.
CHARM AND BEAUTY PHYSICS AT FERMILAB
R. Lipton Jan. 1992 34 p Presented at the 19th SLAC Summer Inst. on Particle Physics, Stanford, CA, 5-16 Aug. 1991
(Contract DE-AC02-76CH-03000)
(DE92-007949; FNAL/C-92/06; CONF-910836-2) Avail: NTIS HC/MF A03

The status of charm and beauty physics studies at Fermilab is reviewed. Data from fixed target experiments on charm production, semi-leptonic decay, and Cabibbo suppressed decays as well as charmonium studies in antiproton annihilation are described. In addition beauty results from CDF and E653 are reviewed and prospects for studies of B physics at collider detectors are discussed. DOE

N92-25274# Wisconsin Univ., Milwaukee.
INELASTIC ELECTRON SCATTERING FROM SURFACES
S. Y. Tong and D. L. Mills (California Univ., Irvine.) 1991 7 p
(Contract DE-FG02-84ER-45076)
(DE92-007959; DOE/ER-45076/2) Avail: NTIS HC/MF A02

This report contains highlights of accomplishments of the past year, for the University of California, Irvine and the University of Wisconsin, Milwaukee collaboration on surface excitations, and their interactions with low energy electrons. In addition, we present a summary of future research to be carried out in the coming grant year. DOE

N92-25338# International Centre for Theoretical Physics, Trieste (Italy).
SUPERSYMMETRY VIOLATION IN ELEMENTARY PARTICLE-MONOPOLE SCATTERING
A. Casher (Tel-Aviv Univ., Israel) and Y. Shamir Oct. 1991 10 p
(DE92-617005; IC-91/350) Avail: NTIS HC/MF A02

We show that the scattering of elementary particles on solitons (monopoles, fluxons, etc.) in supersymmetric gauge theories violates the relations dictated by supersymmetry at tree level. The violation arises because of the discrepancy between the spectra of bosonic and fermionic fluctuations and because of the fermionic nature of the supersymmetry generators. DOE

N92-25339# International Nuclear Data Committee, Vienna (Austria).
GLOBAL ALPHA-PARTICLE OPTICAL POTENTIALS
N. Ferdous (Oxford Univ., England) Dec. 1991 16 p
(DE92-617296; INDC(BAN)-004/L) Avail: NTIS HC/MF A03

A search for a global optical potential (for alpha-particles) is described. It was not possible to find a potential that was valid for a wide range of energies and nuclei, even treating the absorbing potential as an adjustable parameter for each nucleus. For practical purposes the best that can be done is to define an average potential, and such a potential is compared with a wide range of experimental data. Its energy variation is determined by fitting the total reaction cross-section. DOE

N92-25352# Sandia National Labs., Albuquerque, NM.
MULTIPLE SCATTERING BACKGROUND IN HEAVY ION BACKSCATTERING SPECTROMETRY
D. K. Brice Dec. 1991 39 p
(Contract DE-AC04-76DP-00789)
(DE92-008457; SAND-91-1466) Avail: NTIS HC/MF A03

An analytical expression and an integral representation are presented for the contribution, Y(sup n) = Sigma(sup n)(delta)Omega(sub n), of n-event multiple scattering chains to the observed backscattering spectrum in heavy-ion backscattering (HIBS) measurements. The approximations introduced in deriving the results are chosen such that an upper limit is placed on Y(sup n) by the expressions. The Rutherford elastic scattering cross section is used to describe individual collisions between incident projectiles and target atoms. Screening of the Rutherford scattering cross section is included in an approximate fashion which maintains the upper limit estimate. Inelastic energy loss between collision events is assumed proportional to the projectile velocity. Specific application of theses expressions is made to HIBS detection of trace amounts of heavy atom impurities on a Si by 200 - 400 keV C(+) beams. The predicted multiple scattering background for this applications is compared with the predicted single scattering signal for 10(exp 10) atoms/sq cm of Fe, Cu, Zr, Sn, or Au, as surface impurity. The comparison shows that the multiple scattering background poses no barrier to extending the sensitivity of HIBS detection of impurities in this mass range to levels as low as 10(exp 8) atoms/sq cm for the upper part of the energy range considered. Comparison of calculations with and without screening included show that the screening of the Rutherford cross section by atomic electrons is a significant factor in preventing multiple scattering effects from interfering with HIBS spectrometry at impurity levels in the 10(exp 10) atoms/sq cm range. DOE

N92-25353# International Centre for Theoretical Physics, Trieste (Italy).
CANONICAL QUANTIZATION OF NONLOCAL THEORIES RELATED TO BOSONIZATION IN 2 + 1D
R. L. P. G. doAmaral (Pontificia Univ. Catolica, Rio de Janeiro, Brazil) and E. C. Marino Aug. 1991 26 p
(DE92-616923; IC-91/300) Avail: NTIS HC/MF A03

We present a canonical formulation for theories whose actions contain non-integer powers of the d'Alembertian operator and which were recently shown to play a central role in 2 + 1D bosonization. We show that these theories possess an infinite number of constraints and use the Dirac method in order to obtain the classical brackets. The causal and classical Green functions are obtained and their meaning in terms of field expectation values is discussed. The Wightman functions are introduced and shown to lead to the microcausality principle. A mode expansion for the field is obtained. This permits the reobtention of the Wightman functions as vacuum expectation values of products of the basic fields. Creation and annihilation operators are naturally introduced but, as shown, they are not related to definite mass particle states. This is also confirmed by the spectral decomposition of the Wightman functions. DOE

N92-25356# Lawrence Livermore National Lab., CA.
TABLES AND GRAPHS OF ELECTRON-INTERACTION CROSS SECTIONS FROM 10 eV TO 100 GeV DERIVED FROM THE LLNL EVALUATED ELECTRON DATA LIBRARY (EEDL), Z = 1 TO 100
S. T. Perkins, D. E. Cullen, and S. M. Seltzer (National Inst. of Standards and Technology, Gaithersburg, MD.) 12 Nov. 1991 500 p
(Contract W-7405-eng-48)
(DE92-007986; UCRL-50400-Vol-31) Avail: NTIS HC/MF A21

Energy-dependent evaluated electron interaction cross sections and related parameters are presented for elements H through Fm

(Z = 1 to 100). Data are given over the energy range from 10 eV to 100 GeV. Cross sections and average energy deposits are presented in tabulated and graphic form. In addition, ionization cross sections and average energy deposits for each shell are presented in graphic form. This information is derived from the Livermore Evaluated Electron Data Library (EEDL) as of July, 1991. DOE

N92-25358# Indiana Univ., Bloomington.
THEORETICAL STUDIES IN MEDIUM-ENERGY NUCLEAR AND HADRONIC PHYSICS
C. J. Horowitz, M. H. Macfarlane, Tetsuo Matsui, and B. D. Serot 3 Dec. 1991 34 p
(Contract DE-FG02-87ER-40365)
(DE92-009894; DOE/ER-40365/5) Avail: NTIS HC/MF A03

In the period covered by this report (April 1, 1991 to March 31, 1992), work focused on six main areas: (1) relativistic theories of nuclear structure and saturation; (2) relativistic descriptions of proton-nucleus and electron-nucleus scattering; (3) nonrelativistic theory of nucleon-nucleus reactions; (4) relativistic many-body theory at finite temperature and density; (5) neutrino interactions in dense matter; and (6) quark models of nuclear and quark matter. DOE

N92-25445# Technische Univ., Delft (Netherlands).
THE DYNAMIC NONLINEAR SIGMA MODEL OF ELECTRON LOCALIZATION Ph.D. Thesis
Marcus Leonard Horbach 1991 90 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(ETN-92-90976) Avail: NTIS HC/MF A05

The development of a setup for heat capacity measurements below 1K is described. An overall description of the experimental setup and the block diagrams of the equipment used is given. An overview of the transport phenomena in the disordered electron system is given. The diagrammatic perturbation theory is reviewed, and its limitations in going beyond the lowest order are indicated. The replica and superfield methods are reviewed, and so called electron loop contributions to physical quantities are discussed. Such contributions must vanish. The equivalent in the dynamic formulation is addressed. The basic framework in which the dynamic nonlinear sigma model is derived, the time path formalism, is introduced. The calculation of the conductivity from the dynamic nonlinear sigma model, and its renormalization, are discussed. In particular, attention is given to the mechanism which causes the electron loop contributions to vanish. Time dependent disorder is shown to serve as a cutoff effect for localization, which leads to anomalous temperature dependence of the conductance at very low temperatures. ESA

N92-25494# Lawrence Livermore National Lab., CA.
PHASE EFFECTS IN TWO-COLOR MULTIPHOTON PROCESSES
K. C. Kulander and K. J. Schafer 20 Sep. 1991 12 p Presented at the NATO Advanced Research Workshop on Coherence Phenomena in Atoms and Molecules in Laser Field, Hamilton, Ontario, 5-10 May 1992
(Contract W-7405-eng-48)
(DE92-006901; UCRL-JC-108407; CONF-920582-1) Avail: NTIS HC/MF A03

There has been considerable interest over the past few years in the interactions of atoms and molecules with intense, short pulsed lasers. Measurements and calculations of ionization rates and photoemission rates have been reported for many wavelengths and intensities for single frequency laser fields. More recently, the effects of the presence of a second, intense laser field have been considered. Predictions that ionization dynamics can be controlled using two lasers with a fixed phase relationship between them have been realized in experiments by Chen and Elliot and by Muller, et al. In both experiments the rate for multiphoton ionization was shown to depend on this phase. Muller, et al. also showed that the above threshold ionization (ATI) photoelectron energy distributions were affected. Here we report calculations of the two-color ionization of hydrogen that reproduce these observed phase sensitive effects. We also present angular distributions for the photoelectrons and their variation with the relative phase between the lasers. In addition these calculations address the question of the magnitude of the ponderomotive shift of the ionization potential caused by the combined laser fields. In this paper, we present a brief description of our theoretical methods. We show in the third section some representative results for the phase dependence of the multiphoton ionization of a hydrogen atom for the two color case 1omega-2omega, where both fields are assumed to have the same intensity. We relate these results to the measurements of Muller, et al. and give our conclusions in the final section. DOE

N92-25537# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
QUANTIFICATION OF 1-D AND 2-D MAGNETIC RESONANCE SPECTROSCOPIC DATA
Wihlelmus Wilhelmina Pijnappel 1991 135 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie, and Netherlands Technology Foundation
(ETN-92-91192) Avail: NTIS HC/MF A07

The quantification of modern parameters of the physical model function that describes an NMR (Nuclear Magnetic Resonance) measurement is addressed. An application of experimental design is given. Singular Value Decomposition (SVD) is introduced and an application of SVD based quantification of an NMR signal of blood is given. The quantification of two dimensional NMR signals is addressed. Two alternatives to SVD based two dimensional signal quantification based on the Evans-Fischl approach are given. Two nonlinear least squares quantification methods, variable projection and Gauss-Newton, are elaborated. An application of the dedicated Gauss-Newton method to quantification of an in vivo one dimensional C-13 NMR measurement is given. For individual titles, see N92-25538 through N92-25541.

N92-25538# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
SAMPLING STRATEGIES FOR MAGNETIC RESONANCE EXPERIMENTS (CHAPTER 2)
R. deBeer, D. vanOrmondt, W. W. F. Pijnappel, J. W. C. vanderVeen, and J. Skilling, ed. *In its* Quantification of 1-D and 2-D Magnetic Resonance Spectroscopic Data 1991 p 16-61 Repr. from Maximum Entropy and Bayesian Methods, 1989 p 291-296, Kluwer Academic Publishers (For primary document see N92-25537 16-72)
Avail: NTIS HC/MF A07

The quantitative analysis of the efficiency of sampling strategies that are intended for resolution enhancement is addressed. The criterion for efficiency is based on the supposition that the ultimate aim of a measurement is the quantification of physical model parameters. Thus, the Cramer-Rao lower bounds are introduced as a measure of the efficiency. ESA

N92-25539# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
RETRIEVAL OF SIGNIFICANT PARAMETERS FROM MAGNETIC RESONANCE SIGNALS VIA SVD (CHAPTER 4)
R. deBeer, W. M. M. J. Bovee, A. A. deGraaf, D. vanOrmondt, W. W. F. Pijnappel, and R. A. F. M. Chamuleau (Academic Medical Center, Amsterdam, Netherlands) *In its* Quantification of 1-D and 2-D Magnetic Resonance Spectroscopic Data 1991 p 62-95 Repr. from SVD and Signal Processing, Algorithms, Applications and Architectures (Netherlands Elsevier Science Publishers B.V.) 1988 p 473-477 Sponsored by Stichting voor Fundamenteel Onderzoek der Materie; Netherlands Technology Foundation; MEDIGON; and Netherlands Organization for the Advancement of Pure Research (For primary document see N92-25537 16-72)
Avail: NTIS HC/MF A07

Work concerning SVD (Singular Value Decomposition) based spectral analysis of a nuclear magnetic resonance signal of blood for diagnostic purposes is presented. The method yields a significant improvement over conventional methods. However, the

size of the data matrix to be decomposed is rather large. Therefore, exploitation of the underlying Hankel structure is wanted. So far, this is an unsolved problem. ESA

N92-25540# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
MAXIMUM LIKELIHOOD ESTIMATION OF POLES, AMPLITUDES AND PHASES FROM 2-D NMR TIME DOMAIN SIGNALS (CHAPTER 7)
R. deBeer, D. vanOrmondt, and W. W. F. Pijnappel *In its* Quantification of 1-D and 2-D Magnetic Resonance Spectroscopic Data 1991 p 96-114 Presented at Int. Conf. Acoust. Speech, Signal Processing, 1989 Sponsored by Stichting voor Fundamenteel Onderzoek der Materie, and Netherlands Technology Foundation (For primary document see N92-25537 16-72)
Avail: NTIS HC/MF A07

Two dimensional (2-D) Nuclear Magnetic Resonance (NMR) is a powerful spectroscopic tool. MR signals are usually measured in the time domain. For analytical purposes, it is often required to quantify a signal in terms of physically relevant model parameters. To this end, a sum of exponentially damped 2-D sinusoids is fitted to the data. The approach can accommodate a full 2-D amplitude matrix as well as unequal numbers of signal poles in the two dimensions. ESA

N92-25541# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
IMPROVED HARMONIC RETRIEVAL FROM NOISY SIGNALS BY INVOKING PRIOR KNOWLEDGE (CHAPTER 9)
R. deBeer, D. vanOrmondt, and W. W. F. Pijnappel *In its* Quantification of 1-D and 2-D Magnetic Resonance Spectroscopic Data 1991 p 115-119 Rept. from Signal Processing 4: Theories and Applications, Eurasip, 1988 p 1283-1286 Sponsored by Stichting voor Fundamenteel Onderzoek der Materie, and Netherlands Technology Foundation (For primary document see N92-25537 16-72)
Avail: NTIS HC/MF A07

Nuclear Magnetic Resonance (NMR) is becoming an important tool in medical diagnostics. The NMR signal is recorded in the time domain and comprises a number of exponentially decaying complex sinusoids plus white noise. For diagnostic work, the parameters of the sinusoids must be quantified as accurately as possible, and this in a minimum amount of time. This is achieved by exploiting prior knowledge of model parameters and the mathematical properties of the exponential model function. ESA

N92-25950# National Inst. for Fusion Science, Nagoya (Japan).
PARTIAL AND TOTAL ELECTRONIC STOPPING CROSS SECTIONS OF ATOMS FOR A SINGLY CHARGED HELIUM ION, PART 2
T. Kaneko, M. Nishikori, and N. Yamato Aug. 1991 52 p
(DE92-768074; NIFS-Data-13-Pt-2) Avail: NTIS HC/MF A04

Partial and total electronic stopping cross sections of atoms with Z (55 less than or equal to Z less than or equal to 92) for a He(+) ion are tabulated as the second part of results on the basis of the wave-packet theory. The results are extended from earlier work. DOE

N92-25975# University of Northern Illinois, De Kalb.
STUDIES OF HIGH ENERGY PHENOMENA USING MUONS Report, Mar. - Dec. 1991
1991 16 p
(Contract DE-FG02-91ER-40641)
(DE92-008876; DOE/ER-40641/1) Avail: NTIS HC/MF A03

This report discusses the activities of the Northern Illinois University high-energy physics group. The group has three main efforts. The first is the D0 experiment at the Fermilab proton-antiproton collider, with major emphasis on its muon system. The second is the involvement of a portion of the group in Fermilab Experiment 789. Finally, we are also members of the SDC collaboration at the SSC. DOE

N92-25976# Iowa Univ., Iowa City.
POLARIZING MATTER AND ANTIMATTER: A NEW METHOD
Y. Onel Feb. 1992 64 p
(Contract DE-FG02-91ER-40644)
(DE92-008877; DOE/ER-40644/1) Avail: NTIS HC/MF A04

Several years ago a self-polarization effect in stored antiprotons and ions was investigated theoretically. The effect is based on the well-known Stern-Gerlach effect in gradient fields. The aim of the ongoing measurements at the Indiana University Cyclotron Facility (IUCF) is to verify experimentally the various assumptions on which this effect is based. The final goal is to demonstrate this new polarization effect. The proposed effect could be a powerful tool to produce polarized stored hadron beams both in the low-energy range and at SSC and LHC energies. In this progress report we will describe our progress in three parts: (1) experimental work at IUCF Cooler Ring; (2) our extensive computer simulations of the spin stability for the IUCF Cooler Ring; and (3) theoretical studies. DOE

N92-25978# Polish Academy of Sciences, Warsaw. Inst. Podstawowych Problemow Techniki.
SOLITON FORMATION FROM THE INCIDENT GAUSSIAN BEAM IN KERR MEDIUM
D. Burak and W. Nasalski 1991 21 p
(ISSN-0208-5658) Avail: NTIS HC/MF A03

The self focusing of Gaussian beam entering the nonlinear Kerr medium is investigated using the inverse scattering method. The Gaussian field distribution in a transverse cross section is assumed as an initial condition for the nonlinear schroedinger equation. A threshold condition of self focusing as a condition of the solution appearance in the spectrum is given. The evolution of an initial Gaussian envelope into solution envelope is studied and the condition of self trapping in the near field is found. Author

N92-25979# Polish Academy of Sciences, Warsaw. Inst. Podstawowych Problemow Techniki.
TRANSFER MATRIX FOR THE NONSPECULAR DIFFRACTION OF GAUSSIAN BEAMS
Wojciech Nasalski and Witold Samborski 1991 12 p
(ISSN-0208-5658) Avail: NTIS HC/MF A03

Nonspecular deformations of a Gaussian beam interacting with a multilayered, planar dielectric structure are described in terms of the complex ray formalism. A three dimensional transfer matrix of the structure is built and relations between the transfer matrix elements and real beam distortions are derived. Author

N92-26078# Colorado State Univ., Fort Collins. Dept. of Chemistry.
EXCITED STATE PROTON TRANSFER IN 1-NAPHTHOL/AMMONIA CLUSTERS
E. R. Bernstein, M. F. Hineman, G. A. Brucker, and D. F. Delley 4 Feb. 1992 27 p
(Contract N00014-89-J-1237)
(AD-A245849; TR-78) Avail: NTIS HC/MF A03

Proton transfer is a central mechanistic and kinetic step in a large number of important reactions. Reactions involving proton transfer are strongly affected by the surrounding solvent: several studies of proton transfer mechanisms and dynamics in bulk condensed phases have appeared encompassing solvent, pH, and isotope effects. In these studies, the effects observed can be related to the bulk properties of the solvent. The individual effects of solvent molecules and solute-solvent geometry can also be explored in the condensed phases through the study of matrix isolated clusters. Gas phase studies of clusters and cluster chemistry are also now appearing, which can provide additional microscopic details of the solute-solvent structure and the affect of solvent on solute-solvent chemistry (e.g., proton transfer). These latter studies are of both a static and dynamic nature. GRA

N92-26092# Northeastern Univ., Boston, MA.
TOPICS IN GAUGE THEORIES AND THE UNIFICATION OF ELEMENTARY PARTICLE INTERACTIONS

Y. N. Srivastava and M. T. Vaughn Feb. 1992 9 p
(Contract DE-FG02-85ER-40233)
(DE92-010019; DOE/ER-40233/7) Avail: NTIS HC/MF A02

A description of work currently in progress is given. The following topics are covered: fermionic composite models, gravitational diamagnetism, dynamical Casimir effect, N-particle amplitudes for large N beyond the three approximation, and analysis of classical scalar phi(sup 4) field theory. DOE

N92-25532 National Physical Lab., Teddington (England).
ASPECTS OF LIQUID SCINTILLATION COUNTING
J. C. J. Dean *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 5-6 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

N92-25533 National Physical Lab., Teddington (England).
GAMMA INTERCOMPARISON EXERCISE
S. M. Jerome *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 7-9 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

N92-25536 National Physical Lab., Teddington (England).
NAMAS UPDATE
I. W. Goodier *In its* Environmental Radioactivity Intercomparison Workshop Sep. 1991 p 14-15 (For primary document see N92-25530 16-45)
Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N92-25172# Cornell Univ., Ithaca, NY. Lab. of Plasma Studies.
HIGH REPETITION RATE INTENSE ION BEAM SOURCE
D. A. Hammer, S. C. Glidden, and B. Noonan 24 Jan. 1992 30 p
(Contract DE-AC03-87SF-16731)
(DE92-008879; DOE/SF-16731/T1) Avail: NTIS HC/MF A03

This final report describes a less than or equal to 150kV, 40kA, 100ns high repetition rate pulsed power system and intense ion beam source which is now in operation at Cornell University. Operation of the Magnetically-controlled Anode Plasma (MAP) ion diode at greater than 100Hz (burst mode for up to 10 pulse bursts) provides an initial look at repetition rate limitations of both the ion diode and beam diagnostics. The pulsed power systems are capable of greater than or equal to 1kHz operation (up to 10 pulse bursts), but ion diode operation was limited to approximately 100Hz because of diagnostic limitations. By varying MAP diode operating parameters, ion beams can be extracted at a few 10s of keV or at up to 150keV, the corresponding accelerating gap impedance ranging from about 1 omega to about 10 omega. The ability to make hundreds of test pulses per day at an average repetition rate of about 2 pulses per minute permits statistical analysis of diode operation as a function of various parameters. Most diode components have now survived more than 10(exp 4) pulses, and the design and construction of the various pulsed power components of the MAP diode which have enabled us to reach this point are discussed. A high speed data acquisition system and companion analysis software capable of acquiring pulse data at 1ms intervals (in bursts of up to 10 pulses) and processing it in less than or equal to one min. is described. DOE

N92-25462# Superconducting Super Collider Lab., Dallas, TX.
DIRECT SIMULATION OF BEAM DENSITY EVOLUTION IN PHASE SPACE: PRELIMINARY MODELING IN ONE DEGREE OF FREEDOM
S. K. Dutt, J. A. Ellison, T. Garavaglia, S. K. Kauffmann, T. Sen, M. J. Syphers, and Y. T. Yan Oct. 1991 17 p Presented at the 5th International Committee for Future Accelerators (ICFA) Beam Dynamics Workshop, Corpus Christi, TX, 3-8 Oct. 1991 Submitted for publication
(Contract DE-AC35-89ER-40486)
(DE92-007648; SSCL-Preprint-2; CONF-9110243-12) Avail: NTIS HC/MF A03

The concept of phase space density provides a properly macroscopic description of a beam bunch of mutually non-interacting particles. Ideally, simulations of particle beam behavior ought to concentrate directly on the dynamics of the beam phase space density rather than on that of individual particles - an immediate benefit being the elimination of the statistical uncertainty inevitably arising from the sampling of such particles. Here a preliminary step is taken in the direction of this desirable goal - a 'toy' one-degree-of-freedom (the transverse horizontal) beam phase space density is simulated for a highly simplified lattice consisting of a purely linear FODO ring which contains a single thin-element nonlinear kick. These meager ingredients produce a fascinating collection of beam density snapshots in the phase space - including such phenomena as the filamentation and 'fragmentation' of a kicked beam, the process of formation of phase space islands under a variety of circumstances, and spiral twisting of the beam density within the dynamic aperture. DOE

N92-25495# Brookhaven National Lab., Upton, NY.
RADIATION STUDIES OF OPTICAL INTERFEROMETRIC MODULATORS WITH FAST NEUTRONS AND HIGH ENERGY GAMMA-RAYS
T. Tsang, V. Radeka, C. H. Bulmer, and W. K. Burns (Naval Research Lab., Washington, DC.) Nov. 1991 8 p Presented at the CLEO/QELS '92, Anaheim, CA, 10-17 May 1992
(Contract DE-AC02-76CH-00016)
(DE92-007145; BNL-46974; CONF-920573-6) Avail: NTIS HC/MF A02

The possibility of using Ti : LiNbO3 and single mode fibers for nuclear particle detection and transmission in large-scale machines, such as Superconducting Super Collider, calls for a detailed radiation damage study. In this report, we present radiation studies on Ti : LiNbO3 Mach-Zehnder interferometric optical modulators with fast neutrons and high energy Gamma-rays. DOE

N92-25952# National Lab. for High Energy Physics, Tsukuba (Japan).
PARITY VIOLATION IN NEUTRON INDUCED REACTIONS
V. P. Gudkov Jun. 1991 45 p
(DE92-768076; KEK-91-2) Avail: NTIS HC/MF A03

The theory of parity violation in neutron induced reactions is discussed. Special attention is paid to the energy dependence and enhancement factors for the various types of nuclear reactions and the information which might be obtained from P-violating effects in nuclei. DOE

N92-25991# California Univ., Berkeley. Lawrence Berkeley Lab.
ELECTROMAGNETIC DISSOCIATION OF U-238 IN HEAVY-ION COLLISIONS AT 120 MeV/A Ph.D. Thesis
M. L. Justice Apr. 1991 106 p
(Contract DE-AC03-76SF-00098)
(DE92-008313; LBL-31704) Avail: NTIS HC/MF A06

This thesis describes a measurement of the heavy-ion induced electromagnetic dissociation of a 120 MeV/A U-238 beam incident on five targets: Be-9, Al-27, Cu, Ag, and U. Electromagnetic dissociation at this beam energy is essentially a two step process involving the excitation of a giant resonance followed by particle decay. At 120 MeV/A there is predicted to be a significant contribution of the giant quadrupole resonance to the EMD cross sections. The specific exit channel which was looked at was

projectile fission. The two fission fragments were detected in coincidence by an array of solid-state (Delta)E-E detectors, allowing the changes of the fragments to be determined to within (+/-) .5 units. The events were sorted on the basis of the sums of the fragments' charges, acceptance corrections were applied, and total cross sections for the most peripheral events were determined. Electromagnetic fission at the beam energy of this experiment always leads to a true charge sum of 92. Due to the imperfect resolution of the detectors, charge sums of 91 and 93 were included in order to account for all of the electromagnetic fission events. The experimentally observed cross sections are due to nuclear interaction processes as well as electromagnetic processes. Under the conditions of this experiment, the cross sections for the beryllium target are almost entirely due to nuclear processes. The nuclear cross sections for the other four targets were determined by extrapolation from the beryllium data using a geometrical scaling model. After subtraction of the nuclear cross sections, the resulting electromagnetic cross sections are compared to theoretical calculations based on the equivalent photon approximation. Systematic uncertainties are discussed and suggestions for improving the experiment are given. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers*.

N92-25166# EG and G Energy Measurements, Inc., Goleta, CA.
POLARIZATION CONTROL SYSTEMS
B. Marshall 1991 10 p Presented at the 6th Photonics Workshop; DARPA/Rome Laboratory Symposium on Photonics Systems for Antenna Applications, Santa Barbara, CA, 2-4 Oct. 1991; and Monterey, CA, 10-12 Dec. 1991
(Contract DE-AC08-88NV-10617)
(DE92-007906; EGG-10617-2128; CONF-9110233-13; CONF-911267-2) Avail: NTIS HC/MF A02

Integrated optic modulators presently require a stable, polarized optical carrier. In those situations where the modulator is placed some distance from the optical source, it is necessary to compensate for birefringence variations in the optical fiber connecting the source to the modulator. One solution to this problem is an active polarization control system. Alternatively, the carrier can be effectively depolarized. We present here a brief discussion of our experience with these two systems. DOE

N92-25168# Oak Ridge National Lab., TN.
OVERVIEW OF SILICONE-RUBBER FIBER OPTIC SENSORS AND THEIR APPLICATIONS
J. D. Muhs, D. B. Smith, and S. W. Allison 1991 10 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-009013; CONF-9109230-12) Avail: NTIS HC/MF A02

A novel technique for measuring several physical parameters using a transparent, silicone-rubber optical fiber is described. A discussion of the physical and optical characteristics of the fiber is provided along with preliminary experimental results on various present and future sensor applications. These applications include fiber optic sensors for detecting and measuring (1) temperature, (2) humidity/moisture, (3) force, and (4) static and dynamic pressure. DOE

N92-25471# Sandia National Labs., Albuquerque, NM.
DISTINGUISHING CAST SHADOW BOUNDARIES FROM ABRUPT OBJECT BOUNDARIES VIA EDGE DETECTION
G. C. Osbourn 1991 16 p Presented at the 10th SPIE Intelligent Robotics and Computer Vision on Algorithms and Techniques, Boston, MA, 10-15 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-007526; SAND-91-0734C; CONF-9111184-1) Avail: NTIS HC/MF A03

Distinguishing shadow boundaries from object boundaries is a difficult task for machine vision system. A new edge detector is presented which produces qualitatively distinguishable edge signals at shadow penumbras and abrupt object edges. The detector requires the use of spatially extended light sources and sufficient video resolution to resolve the shadow penumbras of interest. A novel approach to high frequency noise suppression is employed which requires no image-dependent adjustment of signal thresholds. The ability of the operator to distinguish shadow penumbras from abrupt object boundaries while suppressing responses to high frequency noise and texture is illustrated with a number of video images. Similarities between this approach and the perception of shadow boundaries by the human visual system are discussed. DOE

N92-25805# Brookhaven National Lab., Upton, NY.
OPTICAL TECHNIQUES FOR MEASUREMENT OF HIGH TEMPERATURES
J. T. Veligdan 25 Oct. 1991 8 p
(Contract DE-AC02-76CH-00016)
(DE92-009152; BNL-47056) Avail: NTIS HC/MF A02

The availability of instrumentation to measure the high outlet gas temperature of a particle bed reactor is a topic of some concern. There are a number of possible techniques with advantages and disadvantages. In order to provide some baseline choice of instrumentation, a review has been conducted of these various technologies. This report summarizes the results of this review for a group of technologies loosely defined as optical techniques (excluding optical pyrometry). The review has concentrated on a number of questions for each technology investigated. These are: (1) Description of the technology; (2) Anticipated sensitivity and accuracy; (3) Requirements for implementation; (4) Necessary development time and costs; and (5) Advantages and disadvantages of the technology. Each of these areas was considered for a technology and a large number of technologies were considered in a review of the literature. Based upon this review it was found that a large number of methods exist to measure temperatures in excess of 2000 K. None of the methods found were ideal. Four methods, however, appeared to warrant further consideration: opto-mechanical expansion thermometry, surface Raman spectroscopy, gas-phase Raman spectroscopy and coherent anti-Stokes Raman spectroscopy (CARS). These techniques will be discussed further in this document. DOE

N92-26150# Naval Underwater Systems Center, New London, CT.
MODE TRANSITION MATRIX FOR MULTIMODE OPTICAL FIBER SYSTEMS
Thomas J. Gryk 9 Dec. 1991 58 p
(AD-A245734; NUSC-TD-9015) Avail: NTIS HC/MF A04

This report discusses the Mode Transition Matrix formalism for determining the loss exhibited by a multimode, passive fiber optic component. This report presents a theoretical discussion of the technique including a detailed description of the approximations made by the matrix formalism. The report experimentally verifies that the modal properties of passive components can be described using a two dimensional matrix. This matrix description allows an accurate prediction of the device's loss when incorporated in a concatenation with other fiber optic components. Finally, the report introduces an invention which allows the mode transition matrix to be determined quickly and accurately. This invention uses fiber optic switches and mode filters to determine the transition matrix and therefore does not require a measurement of the fiber's near field pattern. GRA

N92-26159# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GORDON RESEARCH CONFERENCE ON NONLINEAR OPTICS AND LASERS Final Progress Report, 15 Mar. - 31 Dec. 1991
Hermann Haus 5 Feb. 1992 15 p Sponsored in part by AFOSR
(Contract N00014-91-J-1579; NSF ECS-91-11835)
(AD-A245747) Avail: NTIS HC/MF A03

The topics chosen were production of X rays with high power

lasers, generation of millimeter waves with femtosecond pulses, microcavities and microlasers, second harmonic generation in fibers and advances in photorefractivity and parallel optical processing. It introduces ways of thinking and scientific methods in fields that are related, but would not generally appear in specialized conferences. There were three such examples: the methods of nonlinear optics as applied to electronic signal processing, the concept of squeezing (special quantum states of the electromagnetic field) as used to explain the generation of gravitational waves in the expanding universe, and particle interferometers with particle- instead of wave-gratings. By asking Nobel laureate Bloembergen one year in advance to give the traditional after dinner speech, we were privileged to hear him speak of the history of optics over the centuries resulting in the various principles of linear optics, and the highly accelerated pace of discovery of the analogous principles in nonlinear optics.
GRA

N92-25623# Japan Resources Observation System Organization.
DEVELOPMENT STATUS OF JERS-1 OPTICAL SENSOR SYSTEM
Hiromi Ono *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop 2 Nov. 1990 p 19-28 (For primary document see N92-25620 16-43)
(EW-3) Avail: NTIS HC/MF A08

N92-25793# Helsinki Univ. of Technology, Espoo (Finland). Observatory and Astrophysics Lab.
SINGLE AEROSOL PARTICLE SCATTERING PROFILE MEASURING TECHNIQUES BY PICOBALANCE, MODIFIED MILLIKAN'S CHAMBER
Sampo Ylaetalo and Kari Lumme *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 77 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N92-25213# Lawrence Livermore National Lab., CA.
CHARACTERIZATION OF A CAPILLARY DISCHARGE PLASMA WITH A SLOTTED GEOMETRY Ph.D. Thesis
N. S. Edison 22 Jan. 1992 166 p
(Contract W-7405-eng-48)
(DE92-009598; UCRL-LR-109531) Avail: NTIS HC/MF A08

A capillary plasma is created by using electrical energy from the discharge of a capacitor through a slotted insulator. The discharge of a capacitor through the insulator vaporizes the walls inside the insulator producing a plasma with a temperature on the order of a few electron volts and electron densities on the order of 10(exp 19)/cu cm. If one of the electrodes across the insulator is similarly slotted, the plasma emerges from the capillary electrode as a jet lasting several microseconds. The nature of the capillary device allows much flexibility in the geometry of the plasma generated. In addition, the temperature and density can be controlled by varying the rate and energy of the capacitor discharge. The temperature and density have been determined both spatially and temporally for various discharge energies of a capillary plasma defined by an electrode aperture 1.0 cm long and 200, 400, or 800 microns wide. The temperature is determined by assuming that the plasma radiates as a blackbody and then comparing the spectral surface luminosity to a standard source. The density is determined by interferometry using a pulsed laser to provide a spatial profile at a particular time after the discharge has begun. This device is an inexpensive plasma source which may be used to conduct laser plasma interaction experiments. DOE

N92-25275*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
PLASMA CONTACTOR RESEARCH - 1991 Annual Report, 1 Jan. 1991 - 1 Jan. 1992
Brett Buchholtz, John D. Williams, and Paul J. Wilbur Apr. 1992 62 p
(Grant NAG3-776)
(NASA-CR-189140; NAS 1.26:189140) Avail: NTIS HC/MF A04

A report describing the operating principles of hollow-cathode-based plasma contactors emitting or collecting electrons from an ambient plasma is summarized. Preliminary experiments conducted to determine the noise generated by these plasma contactors in the emission-current return line and in the plasma near it are described. These noise data are measured as current fluctuations in the return line and to the Langmuir probe and then analyzed using a fast Fourier transform technique. The spectral compositions of the data are characterized using power spectral density plots which are examined to identify possible noise source(s) and production mechanism(s). The precautions taken in the construction and calibration of the instrumentation to assure adequate frequency response are described. Experimental results show that line-current noise levels are typically 2 percent of the electron current being emitted or collected. However, noise levels increase to as much as 20 percent of the electron current at a few electron-collection operating conditions. The frequencies associated with most of the noise were harmonics of the 60 Hz input to system power supplies. Plasma noise had characteristics similar in magnitude and frequency to those for the return-line noise, but they contained additional features at frequencies considered to be related to ion-acoustic instabilities. Also discussed is a new probe positioning system built to facilitate future plasma-contractor research. Author

N92-25320# General Atomic Co., San Diego, CA.
FUSION PROGRAMS IN APPLIED PLASMA PHYSICS
Feb. 1992 68 p
(Contract DE-AC03-89ER-53277)
(DE92-009646; GA-A-20803) Avail: NTIS HC/MF A04

The objectives of the theoretical science program are: to support the interpretation of present experiments and predict the outcome of future planned experiments; to improve on existing models and codes and validate against experimental results; and to conduct theoretical physics development of advanced concepts with applications for DIII-D and future devices. Major accomplishments in FY91 include the corroboration between theory and experiment on MHD behavior in the second stable regime of operation on DIII-D, and the frequency and mode structure of toroidal Alfven eigenmodes in high beta, shaped plasmas. We have made significant advances in the development of the gyro-Landau fluid approach to turbulence simulation which more accurately models kinetic drive and damping mechanisms. Several theoretical models to explain the bifurcation phenomenon in L- to H-mode transition were proposed providing the theoretical basis for future experimental verification. The capabilities of new RF codes have been upgraded in response to the expanding needs of the RF experiments. Codes are being employed to plan for a fully non-inductive current drive experiment in a high beta, enhanced confinement regime. GA's experimental effort in applied physics encompasses two advanced diagnostics essential for the operation of future fusion experiments: alpha particle diagnostic, and current and density profile diagnostics. This paper discusses research in all these topics. DOE

N92-25329# Lawrence Livermore National Lab., CA.
DIAGNOSTICS DATA MANAGEMENT ON MTX
D. N. Butner, M. D. Brown, T. A. Casper, W. H. Meyer, and J. M. Moller Sep. 1991 7 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-009466; UCRL-JC-107246; CONF-910968-74) Avail: NTIS HC/MF A02

The Microwave Tokamak Experiment (MTX) is a magnetic fusion energy research experiment to explore electron cyclotron

heating using a free electron laser operating in the microwave range. The diagnostic data from MTX is acquired and processed by a distributed, multivendor, computer network. Each shot of the experiment produces data files containing up to 15 megabytes of data. Typically half-second shots are taken every 5 minutes with 50 to 60 shots taken on a single day. As many as 80 full data shots have been taken on a good day. Data files are created on Hewlett-Packard (HP) computers running Unix, HP computers running BASIC, and a Digital Equipment Corporation (DEC) VAXcluster running VMS. A small portion of the data acquired on the HP systems is immediately stored in a data system on the VAXcluster, but most data is held and processed on the computer on which it was acquired. A commercial database program running on the VAXcluster maintains a history of the data files created for each shot. During the night, data files on all computers are compressed to about one-third their original size and the files on the HP computers are transferred to the VAXcluster. When enough data has accumulated, all data files that have not been previously archived are archived to 8 mm magnetic tape. Once the data is on the VAXcluster, a single defined procedure call may be used to obtain data that was taken on any of the computers in the network. Data that has been archived to tape is maintained on disk for a few days. Users may specify that certain shots be designated 'goodshots', whose data files will be maintained on disk for a longer period of time. If a user requests data for a shot that is no longer on disk, retrieval processes on the VAXcluster determine which tapes contain the data, request the computer operator to load the tapes if necessary, and retrieve the files from the tapes. The data is then available for processing by programs running on any computer in the network. DOE

N92-25381# Wisconsin Univ., Madison.
TRANSPORT PROCESSES IN MAGNETICALLY CONFINED PLASMAS
J. D. Callen Dec. 1991 41 p Presented at the 33rd Annual Division of Plasma Physics/American Physical Society (DPP/APS) Meeting, Tampa, FL, 4-8 Nov. 1991
(Contract DE-FG02-86ER-53218)
(DE92-004746; UW-CPTC-91-18; CONF-9111127-4) Avail: NTIS HC/MF A03

Intensified studies of plasma transport in toroidal plasmas over the past three to five years have progressed through increased understanding in some areas and changed perceptions about the most important issues in other areas. Recent developments are reviewed for six selected topics: edge fluctuations and transport; L-H mode transition; core fluctuations; modern plasma turbulence theory; transient transport; and global scaling. Some of the developments that are highlighted include: the role of a strongly sheared poloidal flow in edge plasma turbulence, transport and the L-H transition; change of focus from kappa (perpendicular) rho approx. 1 to kappa (perpendicular) rho much less than 1 fluctuations in tokamak plasmas; modern 'Direct Interaction Approximation' plasma turbulence and hybrid fluid/kinetic theoretical models; and transient transport experiments that are raising fundamental questions about our conceptions of local transport processes in tokamaks. DOE

N92-25411# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
SECOND ORDER OSCILLATIONS OF A VLASOV-POISSON PLASMA IN THE FOURIER TRANSFORMED VELOCITY SPACE
Zdenek Sedlacek and Luigi Nocera May 1991 40 p Sponsored in part by Czechoslovak Academy of Sciences; and the Italian National Research Council
(IPPCZ-312) Avail: NTIS HC/MF A03

We study the Vlasov-Poisson system of equations in the Fourier-transformed velocity space. First, we reformulate some results of the linear theory: in the new representation of the Van Kampen-Case eigenmodes and their adjoint are found to be ordinary functions with convenient piece-wise continuity properties. We give a transparent derivation of the free-streaming temporal echo in terms of the kinematics of wave packets in the Fourier transformed velocity space. We further extend this analysis to include Coulomb interactions which allow us to establish connections between the echo theory, the second order oscillations of Best and the phenomenon of linear sidebands. The calculation of the time evolution of the global second order electric field is performed in detail in the case of a Maxwellian equilibrium distribution function. We conclude that the phenomenon of linear sidebands may be properly examined in terms of the intrinsic features of the equilibrium distribution function. Author

N92-25412# Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
ON NONLINEAR CHANGES OF THE REFLECTION COEFFICIENT OF THE FAST WAVE AT LH FREQUENCIES DUE TO PONDEROMOTIVE FORCES
V. Petrzilka Sep. 1991 9 p Presented at the IAEA Meeting on FWCD in Reactor Scale Tokamaks, Arles, France, 23-26 Sep. 1991
(IPPCZ-313) Avail: NTIS HC/MF A02

Nonlinear changes of the reflection coefficient R of fast waves launched by waveguide arrays may be appreciably high. The local heating of the edge plasma by the wave may weaken or even suppress these changes of R. Author

N92-25473# Lawrence Livermore National Lab., CA.
OVERVIEW OF THE MICROWAVE TOKAMAK EXPERIMENT OPERATION AND DEVELOPMENTS
D. D. Lang, S. L. Allen, and H. H. Bell Sep. 1991 5 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-009700; UCRL-JC-107245; CONF-910968-79) Avail: NTIS HC/MF A01

At Lawrence Livermore National Laboratory (LLNL), we assembled and presently operate the Microwave Tokamak Experiment (MTX) to demonstrate the feasibility of using intense microwave pulses (up to 6 GW peak power) from a free electron laser (FEL) to provide electron cyclotron heating (ECH) for use in tokamaks, particularly high field machines. The MTX consists primarily of the ALCATOR C tokamak and power supplies from MIT, along with FEL; the FEL is made up of the ETA-II linear induction accelerator and the IMP steady-state wiggler. A four-barrel pellet injector was added to the tokamak to produce peaked density profiles. The tokamak operations started in November 1988, with full duration plasmas being obtained at a toroidal field of both 5 and 9 tesla. Initial results were obtained with the single pulse 140 GHz FEL at peak power levels of 200 to 400 MW late in 1989. Due to excessive transverse electron beam motion, and arcing in the accelerator cells, the accelerator was modified. These modifications have been successfully tested on a small portion of the rebuilt accelerator and have been incorporated in the remaining portion of the accelerator. A 140 GHz, 400 kW gyrotron was used to perform preliminary heating experiments during the fall of 1990. This same gyrotron system is serving as the master oscillator for the burst mode FEL. The new IMP steady state wiggler will be used to produce the high power microwaves for the burst mode. The FEL construction has been completed, and it will be used for heating experiments scheduled for this fall. This paper describes the recent experimental operations. It also briefly outlines the additions and improvements to the experiment, which are described in more detail in companion papers at this conference. DOE

N92-25486# Japan Atomic Energy Research Inst., Tokyo.
NEOCLASSICAL TRANSPORT ANALYSIS OF TITANIUM IMPURITY IN PLASMAS WITH STRONGLY PEAKED DENSITY PROFILES
Toshio Hirayama, Tatsuo Sugie, Akira Sakasai, Ryuuji Yoshino, and Yutaka Kamada (Japan Atomic Energy Research Inst., Naka.) Oct. 1991 20 p
(DE92-768107; JAERI-M-91-169) Avail: NTIS HC/MF A03

The full neoclassical multi-ion calculation required for the interaction between titanium and light impurities like carbon and oxygen is presented. Intrinsic titanium impurity behavior in pellet fuelled plasmas was studied by applying the neoclassical impurity

transport calculation to temporal evolutions of Ti 20 and Ti 21 spectroscopically observed. Ti impurity accumulates in the plasma core region, correlated with peaked density profile and the absence of sawtooth oscillation. Impurity accumulation is caused by a strong ion density gradient driving force and collisions with light impurities, as the neoclassical impurity transport theory predicts. This impurity behavior is well described by the combination of reduced anomalous diffusion and neoclassical transport in the plasma interior. The reduced anomalous diffusion at the central region inside the q = 1 is estimated to be 0.2 m(sup 2)/s. The outer zones continue to be dominated by anomalous transport. DOE

N92-25487# National Inst. for Fusion Science, Nagoya (Japan).
THOUGHT ANALYSIS ON RELAXATION AND GENERAL PRINCIPLE TO FIND RELAXED STATE
Yoshiomi Kondoh (Gunma Univ., Maebashi, Japan) Sep. 1991 14 p
(DE92-768112; NIFS-109) Avail: NTIS HC/MF A03

A thought analysis on relaxation is presented to lead to a general principle applicable to all dynamical systems to find the relaxed state. The general principle is applied to the energy relaxation of the magnetohydrodynamic (MHD) plasma to lead to the relaxed state of (del operator) x B = lambdaB and the mode transition condition without using the concept of helicity. The present theory permits the quasi-steady energy flow through the boundary surface and leads to a more general relaxed state for plasmas having spatial dependent resistivity, that connects directly to the experimental fact of j = 0 near the wall. DOE

N92-25488# National Inst. for Fusion Science, Nagoya (Japan).
NEOCLASSICAL TRANSPORT ANALYSIS IN THE BANANA REGIME ON LARGE HELICAL DEVICE (LHD) WITH THE DKES CODE
Y. Ogawa, T. Amano, N. Nakajima, Y. Ohyabu, K. Yamazaki, S. P. Hirshman, W. I. VanRij, and K. C. Shaing Sep. 1991 47 p
(DE92-768113; NIFS-108) Avail: NTIS HC/MF A03

Neoclassical transport in the banana regime has been analyzed with the Drift Kinetic Equation Solver (DKES) code for the Large Helical Device (LHD). It is found that in a 1/v regime, diffusion coefficients change by one order of magnitude for various configurations of LHD (-0.2 m less than or equal to Delta less than or equal to 0 m, 0 percent less than or equal to Bq less than or equal to 200 percent, -0.1 less than or equal to alpha less than or equal to 0.1), depending on the structure of the helical magnetic ripple. The neoclassical transport calculated with the DKES code is quantitatively, in good agreement with multi-helicity theory formulated by Shaing and Hokin. Incorporating the multi-helicity effect into the diffusion coefficient, we have proposed an interpolation formula between the 1/v and v regimes. When the ion temperature is increased at a fixed density of n = 10(exp 20) m(exp -3), the ions undergo a transition from 1/v neoclassical transport to the v regime when their temperature T(sub i) becomes greater than 3 keV with radial electric potential e-phi comparable to the ion temperature (e-phi/T(sub i) approx. equal 1). For the optimized configuration (Delta = -0.2 m, Bq = 100 percent), the ion thermal diffusivity chi(sub i) has a maximum value of chi(sub i) approx. equal 3.5 m(exp 2)/s at a minor radius of r/a approx. equal 0.5. The bootstrap current has been also studied, and the results have been comprehensively compared with the theory. At the collisionless limit with a moderate radial electric potential of e-phi/T(sub i) approx. equal 1, the DKES calculations evaluated for various configurations of LHD have supported the theoretical formula given by Shaing and Callen. At the collision frequency between the plateau and the banana regimes, where the analytic theory is not applicable, the bootstrap current might become larger than in the collisionless limit (by a factor of about two), depending on the radial electric fields. DOE

N92-25489# National Inst. for Fusion Science, Nagoya (Japan).
MACROSCALE PARTICLE SIMULATION OF EXTERNALLY DRIVEN MAGNETIC RECONNECTION
Sadayoshi Murakami and Tetsuya Sato Sep. 1991 34 p
(DE92-768114; NIFS-107) Avail: NTIS HC/MF A03

Externally driven reconnection, assuming an anomalous particle collision model, is numerically studied by means of a 2.5D macroscale particle simulation code in which the field and particle motions are solved self-consistently. Explosive magnetic reconnection and energy conversion are observed as a result of slow shock formation. Electron and ion distribution functions exhibit large bulk acceleration and heating of the plasma. Simulation runs with different collision parameters suggest that the development of reconnection, particle acceleration and heating do not significantly depend on the parameters of the collision model. DOE

N92-25491# General Atomic Co., San Diego, CA.
INITIAL FAST WAVE HEATING AND CURRENT DRIVE EXPERIMENTS ON THE D3-D TOKAMAK
R. Prater, M. J. Mayberry, C. C. Petty, R. I. Pinsker, S. C. Chiu, R. W. Harvey, T. C. Luce, M. Porkolab, P. Bonoli, and R. A. James et al Dec. 1991 23 p Presented at the IAEA Technical Committee Meeting on Fast Wave Current Drive in Reactor Scale Tokamaks, Arles, France, 23-25 Sep. 1991
(Contracts DE-AC03-89ER-51114; W-7405-eng-48; DE-AC05-84OR-21400)
(DE92-008241; GA-A-20784; CONF-9109333-2) Avail: NTIS HC/MF A03

Heating and current drive experiments have been performed on the D3-D tokamak using a 4-strap fast wave antenna at power up to 1.7 MW at 30 to 60 MHz. Minority heating experiments using D(H) showed effective wave absorption, confirming that the antenna was launching the fast wave. Experiments on the direct absorption of fast waves by electrons through Landau damping and transit-time magnetic pumping were performed at 60 MHz. These experiments showed effective heating of electrons, with a global heating efficiency comparable to that of neutral injection, even when the calculated single-pass dumping was as small as 5 percent. It is believed that effective multiple-pass damping is taking place. Fast wave current drive experiments were performed with a toroidally directional spectrum obtained by pi/2-phasing of the antenna straps. Although non-inductive currents of up to 160 kA were found, the magnitude of the non-inductive current did not decrease when the wave spectrum was reversed. These results are presently under investigation. DOE

N92-25949# National Inst. for Fusion Science, Nagoya (Japan).
CHAOTIC PHENOMENA IN PLASMAS
Y. Kawai (Kyushu Univ., Fukuoka, Japan) Aug. 1991 44 p
(DE92-768073; NIFS-Memo-4) Avail: NTIS HC/MF A03

It was recently recognized that research into various aspects of chaotic dynamics is growing rapidly as one of the premier areas in nonlinear science. The field of plasma physics is filled with nonlinear phenomena, so it is easy to see why the study of plasma is widespread in chaotic phenomena. Research on plasma chaos is being carried out in such areas as stochastic magnetic field and the chaotic orbit in a toroidal helical system. To review the present status of the research in plasma chaos and to elucidate the basic physics, a working group was organized in 1990 as a collaborative research effort of the National Institute for Fusion Science. This is the report of its activity in 1990. DOE

N92-25972# Texas Univ., Austin. Inst. for Fusion Studies.
THE EFFECT OF CHARGE-EXCHANGE ON PLASMA FLOWS
P. M. Valanju, M. D. Calvin, R. D. Hazeltine, and E. R. Solano Feb. 1992 6 p
(Contract DE-FG05-80ET-53088)
(DE92-008782; DOE/ET-53088/540; IFSR-540) Avail: NTIS HC/MF A02

Recent observations have shown a sudden increase in plasma rotation as a signature of L to H transition. These plasma flows are generally attributed to neutrals causing drag on ion rotation through charge-exchange (CX) collisions. We give a simple drift-kinetic derivation of the expressions for the poloidal ion and

impurity flows in the presence of charge-exchange drag and ion-impurity collisions. DOE

N92-25994# Argonne National Lab., IL.
PERFORMANCE OF MHD INSULATING MATERIALS IN A POTASSIUM ENVIRONMENT
K. Natesan, J. H. Park, D. L. Rink, and C. A. Thomas (Pittsburgh Energy Technology Center, PA.) Dec. 1991 27 p
(Contract W-31-109-eng-38)
(DE92-009553; ANL/MHD-91/1) Avail: NTIS HC/MF A03

The objectives of this study are to evaluate the compatibility of the MHD insulating materials boron nitride and silicon nitride in a potassium environment at temperatures of 1000 and 1400 F (538 and 760 C, respectively) and to measure the electrical conductivities of the specimens before and after exposure to potassium. Based on the test results, an assessment is to be made of the suitability of these materials for application as insulator materials in an MHD channel. DOE

N92-26011# MSE, Inc., Butte, MT.
MAGNETOHYDRODYNAMIC PROJECTS AT THE CDIF
1991 22 p
(Contract DE-AC22-88ID-12735)
(DE92-010011; DOE/ID-12735/T22) Avail: NTIS HC/MF A03

The Component Development and Integration Facility (CDIF) is a major US Department of Energy magnetohydrodynamic (MHD) test facility in Butte, Montana. The CDIF is operated by MSE, Inc. Within the national MHD program, MSE personnel are responsible for performing integration testing of vendor-supplied MHD power train components at the CDIF to support the goal of commercialization. During the first quarter of FY92, MHD testing was initiated. Off-line and on-line calibration tests were completed for the Endress+Hauser flowmeter, and thermal, conductivity, and electrical testing was initiated. DOE

N92-26031# Lawrence Livermore National Lab., CA.
HIGH DENSITY TURBULENT PLASMA PROCESSES FROM A SHOCK TUBE
O. Oyedeji and J. A. Johnson, III (City Coll. of the City Univ. of New York, NY.) 15 Jul. 1991 11 p Prepared in cooperation with Clark Atlanta Univ., GA
(Contract W-7405-eng-48)
(DE92-009688; UCRL-CR-109351) Avail: NTIS HC/MF A03

We have finished the first stages of our experimental and theoretical investigations on models for energy and momentum transport and for photon-particle collision processes in a turbulent quasi-stationary high density plasma. The system is explored by beginning to determine the turbulence phenomenology associated with an ionizing shock wave. The theoretical underpinnings are explored for phonon particle collisions by determining the collisional redistribution function, using Lioville Space Green's Function, which will characterize the inelastic scattering of the radiation from one frequency to another. We have observed that a weak magnetic field tends to increase the apparent random-like behaviors in a collisional turbulent plasma. On the theoretical side, we have been able to achieve a form for the collisional redistribution function. It remains to apply these concepts to a stationary turbulent plasma in the reflected ionizing shock wave and to exercise the implications of evaluations of the collisional redistribution function for such a system when it is probed by a strong radiation source. These results are discussed in detail in the publications, which have resulted from this effort, cited at the end of the report. DOE

N92-26111# RADEX, Inc., Bedford, MA.
A TRAPPED ELECTRON MODEL FOR APPLICATION TO THE MACH CODE Technical Report No. 7, Jun. 1989 - Apr. 1991
M. F. Tautz 8 Apr. 1991 22 p
(Contract F19628-89-C-0068; AF Proj. 7659)
(PL-TR-91-2106; RX-R-91041) Avail: NTIS HC/MF A03

A method was developed for modeling the space charge density due to electrons trapped in a potential energy well, and produces stable solutions using the MACH code. The trapped electrons are assumed to thermalize due to collisions with the source electrons, and reach an equilibrium distribution which depends on the well depth. The model has one free parameter, and requires evaluation of a quadrature. The basic equations and some numerical results are presented. A comparison of a plasma chamber simulation is given, using the model and measured data. Author

N92-26139# California Univ., Berkeley.
HEAVY ION DRIVEN LMF DESIGN CONCEPT
E. P. Lee Aug. 1991 42 p
(Contract DE-AC03-76SF-00098)
(DE92-009489; LBL-31248; HIFAN-526) Avail: NTIS HC/MF A03

The US Department of Energy has conducted a multi-year study of the requirements, designs and costs for a Laboratory Microfusion Facility (LMF). The primary purpose of the LMF would be testing of weapons physics and effects simulation using the output from microexplosions of inertial fusion pellets. It does not need a high repetition rate, efficient driver system as required by an electrical generating plant. However there would be so many features in common that the design, construction and operation of an LMF would considerably advance the application of inertial confinement fusion to energy production. The DOE study has concentrated particularly on the LMF driver, with design and component development undertaken at several national laboratories. Principally, these are LLNL (Solid State Laser), LANL (Gas Laser), and SNLA (Light Ions). Heavy Ions, although considered a possible LMF driver did not receive attention until the final stages of this study since its program management was through the Office of Energy Research rather than Defense Programs. During preparation of a summary report for the study it was decided that some account of heavy ions was needed for a complete survey of the driver candidates. A conceptual heavy ion LMF driver design was created for the DOE report which is titled LMC Phase II Design Concepts. The heavy ion driver did not receive the level of scrutiny of the other concepts and, unlike the others, no costs analysis by an independent contractor was performed. Since much of heavy ion driver design lore was brought together in this exercise it is worthwhile to make it available as an independent report. This is reproduced here as it appears in the DOE report. DOE

N92-25767# Helsinki Univ. of Technology, Espoo (Finland). Ilmatieteen Laitos.
PERSPECTIVES ON RESEARCH AND EDUCATION OF SPACE PLASMA PHYSICS [AVARUUSPLASMAFYSIIKAN TUTKIMUS: JA KOULUTUSNAEKYMISTAE SUOMESSA]
Hannu Koskinen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 17-19 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-25272# Argonne National Lab., IL.
PARACONDUCTIVITY MEASUREMENTS AND COMPARATIVE STUDIES OF FLUCTUATIONS IN BiSrCaCuO AND YBaCuO WITH Gd SUBSTITUTION
S. K. Patapis, L. Sideridis, G. Apostolopoulos, M. Ausloos, and H. L. Luo (California Univ., San Diego, La Jolla.) 1991 10 p Presented at the NATO Advanced Study Institute on Physics and Materials Science of High-Temperature Superconductors, Corfu Island (Greece), 18-31 Aug. 1991
(Contract W-31-109-eng-38)
(DE92-007377; ANL/CP-75114; CONF-910860-3) Avail: NTIS HC/MF A02

Information concerning the dimensionality of the superconductive fluctuations in the new high temperature superconductors can be derived from the excess conductivity (or

paraconductivity) near the transition temperature. Here the 'lowering' of the sample resistance in the same temperature regions is used for extraction of dimensionality and generally for comparative studies of the critical behaviour of three different samples such as YBa2Cu3O7, Y(0.8)Gd(0.2)Ba2Cu3O7 and Bi(0.85)Pb(0.15)SrCa(1.2)Cu2O6. The experimental data of the three samples show a similar behavior with some distinct differences depending rather on the 'metallurgical' state of the material than the composition itself. A logarithmic behavior is present for YBaCuO and Y(Gd)BaCuO samples not close to the critical temperature and, the most important, closer to (Tc) YBaCuO shows a fractal behavior, observed for the first time, similar to the one of Bi-compound observed many times before. DOE

N92-25300# Technische Univ., Delft (Netherlands).
ELECTROCHEMICAL STUDIES ON THE OXYGEN REDUCTION AND NIO(Li) DISSOLUTION IN MOLTEN CARBONATE FUEL CELLS Ph.D. Thesis
Robert Christiaan Makkus 1991 213 p
(Contracts EN3E-0151-NL; ECN-SC03)
(ISBN-90-9004383-7; ETN-92-91278) Copyright Avail: NTIS HC/MF A10

A study of the oxygen reduction in molten carbonate on a plane gold electrode submerged in a molten carbonate melt and on three different porous electrodes, made of NiO(Li), LiFeO2 (doped with either Mg or Co) and LiCoO2, is presented. From the impedance measurements made on plane gold electrode, two parallel reaction mechanisms are concluded to be involved in the oxygen reduction: in the first peroxycarbonate is reduced at a partly with oxide covered electrode surface; and in the second the steps could not be unraveled. Partial pressure dependencies of the diffusion arc observed in the impedance of the porous electrodes indicate that both oxygen and carbon dioxide are the diffusing species. From comparison of the ratios of the diffusion and kinetic arc, the catalytic activities of the three materials are concluded not to differ significantly, although this seems to be contradictory to the observation that the impedance for Co doped LiFeO2 is much Larger than for the other materials. This difference, however, is due to the large specific resistivity of Co doped LiFeO2 compared to the resistivity of the other materials. ESA

N92-25319# International Centre for Theoretical Physics, Trieste (Italy).
STRUCTURE AND BONDING IN CLUSTERS
V. Kumar Oct. 1991 34 p
(DE92-619450; IC-91/358) Avail: NTIS HC/MF A03

We review here the recent progress made in the understanding of the electronic and atomic structure of small clusters of s-p bonded materials using the density functional molecular dynamics technique within the local density approximation. Starting with a brief description of the method, results are presented for alkali metal clusters, clusters of divalent metals such as Mg and Be which show a transition from van der Waals or weak chemical bonding to metallic behavior as the cluster size grows, and clusters of Al, Sn, and Sb. In the case of semiconductors, we discuss results for Si, Ge, and GaAs clusters. Clusters of other materials such as P, C, S, and Se are also briefly discussed. From these and other available results we suggest the possibility of unique structures for the magic clusters. DOE

N92-25340# International Centre for Theoretical Physics, Trieste (Italy).
ON THE STATISTICAL MODELS OF CRYSTAL MORPHOLOGY
T. A. Cherepanova, A. V. Stekolnikov, and P. Bennema (Catholic Univ., Nijmegen, Netherlands) Sep. 1991 11 p
(DE92-617434; IC-91/307) Avail: NTIS HC/MF A03

Analytical approaches are developed to describe the thermal disordering of surfaces in noble-gas crystals, based on the Lennard-Jones interaction potential. The roughness of faces with different orientations is described by means of a quasi-lattice model, where the repulsive forces and the contributions of vibrational degrees of freedom are taken into account in the free surface energy. It is shown, that the free surface energy becomes isotropic near the melting temperature. The surface melting is described by the weighted-density functional method. The face-orientation dependences of surface melting and the melt structurization near crystal surface are studied. The effect of long-range Coulomb forces on the atomic structure of the crystal-melt interface is considered. DOE

N92-25392# Rochester Univ., NY. Dept. of Chemical Engineering.
COMPARATIVE STUDY OF THE REACTIONS OF METAL OXIDES WITH H2S AND SO2
S. V. Sotirchos Oct. 1991 6 p
(Contract DE-FG22-90PC-90301)
(DE92-008692; DOE/PC-90301/T3) Avail: NTIS HC/MF A02

The primary objective of this project is the investigation of the effects of pore structure on the capacity of porous metal oxides for removal of gaseous pollutants from flue gases of power plants (SO2) and hot coal gas (primarily H2S). Specifically, we intend to appropriately exploit the differences of the sulfidation and sulfation reactions (for instance, different molar volumes of solid products) to elucidate the dependence of the sorptive capacity of a porous sorbent on its physical microstructure. The following tasks were identified for the proposed project: (1) literature search and identification of solids to be used in experimental studies; (2) experimental study of the reaction of the chosen solids with SO2 and/or H2S; (3) experimental study of the evolution of the structure of the solids during reaction with SO2 and/or H2S using pore structure analysis and effective diffusivity measurements; and (4) model testing and validation using the obtained experimental data. DOE

N92-25394# Argonne National Lab., IL.
X RAY DIFFRACTION STUDY OF GaSb/AlSb STRAINED-LAYER-SUPERLATTICES GROWN ON MISCUT (100) SUBSTRATES
A. T. Macrander, G. P. Schwartz, G. J. Guiltieri, and G. Gilmer (Bell Telephone Labs., Inc., Murray Hill, NJ.) Jul. 1991 12 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-31-109-eng-38)
(DE92-009734; ANL/CP-72290; CONF-9107115-73) Avail: NTIS HC/MF A03

A series of superlattices were grown by molecular beam epitaxy on (100) GaSb substrates which had been miscut by 2, 3, and 4 degrees toward the (011) direction. These superlattices were then studied by scanning all possible (444) or (511) (asymmetric) reflections with high resolution multiple-crystal x-ray diffractometry. In addition, the (400) (quasi-symmetric) reflection was scanned. From peak splittings we extracted mismatch and tilt parameters for the epitaxial unit cell. We compared our results for the non-tetragonal component of the distortion ot calculations based on the coherent strain model of Hornstra and Bartels (J. Cryst. Growth 44,513 (1978)). We find that this model, which was developed for epitaxial growth on a general (hkl) plane, also describes our results for growth on vicinal (100) planes. The resolution of our data is sufficient to establish that the distortion was not purely tetragonal. A monoclinic unit cell symmetry adequately describes our results. DOE

N92-25398* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MACROMOLECULAR CRYSTAL GROWING SYSTEM Patent
Robert S. Snyder, inventor (to NASA), Blair J. Herren, inventor (to NASA), Daniel C. Carter, inventor (to NASA), Vaughn H. Yost, inventor (to NASA), Charles E. Bugg, inventor (to NASA), Lawrence J. DeLucas, inventor (to NASA), and Fred L. Suddath, inventor (to NASA) 7 May 1991 15 p Filed 31 Aug. 1990
(NASA-Case-MFS-26088-1-CU; US-Patent-5,013,531; US-Patent-Appl-SN-575736; US-Patent-Class-422-245; US-Patent-Class-422-247; US-Patent-Class-156-DIG.62; US-Patent-Class-156-DIG.113; Int-Patent-Class-B01D-9/00)
Avail: US Patent and Trademark Office

A macromolecular crystal growing system especially designed

for growing crystals in the low gravity of space as well as the gravity of earth includes at least one tray assembly, a carrier assembly which receives the tray, and a refrigeration-incubation module in which the carrier assembly is received. The tray assembly includes a plurality of sealed chambers with a plastic syringe and a plug means for the double tip of the syringe provided therein. Ganging mechanisms operate the syringes and plugs simultaneously in a precise and smooth operation. Preferably, the tray assemblies are mounted on ball bearing slides for smooth operation in inserting and removing the tray assemblies into the carrier assembly. The plugging mechanism also includes a loading control mechanism. A mechanism for leaving a syringe unplugged is also provided.

Official Gazette of the U.S. Patent and Trademark Office

N92-25490# Lawrence Livermore National Lab., CA.
RELATIVISTIC DIELECTRONIC RECOMBINATION THEORY
Mau Hsiung Chen Nov. 1991 16 p Presented at the NATO Workshop on Recombination of Atomic Ions, Belfast, Ireland, 6-9 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008070; UCRL-JC-109370; CONF-9110313-6) Avail: NTIS HC/MF A03

Dielectronic recombination (DR) is an inverse Auger process in which a free electron is captured by a recombining ion to form a doubly excited autoionizing state. The subsequent decay of the autoionizing state to a stabilized bound state by emitting photons completes the recombination process. DR is an important recombination process for high temperature plasmas. It can affect the ionization balance and level kinetics of the hot plasmas. In addition, the dielectronic satellite lines observed in the emission spectra are frequently used as plasmas diagnostic tools. In the past decade, intense theoretical and experimental studies on the DR process have been carried out. Most of the earlier theoretical calculations on the DR rate coefficients were done either by using a term average approximation or in LS coupling without including the effects of relativity and configuration interaction. The early experimental investigations were concentrated on few times ionized low-Z ions. Recently, the development of electron beam ion trap (EBIT), electron beam ion source (EBIS) and heavy ion storage ring has become possible to produce very highly-charged heavy ions (e.g., U(sup 82+) and Xe(sup 53+))and to study the interaction between electrons and these ions. For highly-charged heavy ions, one excepts that the nonrelativistic method would be inadequate and a relativistic treatment is necessary. To meet this challenge we have developed a relativistic package based on the multiconfiguration Dirac-Fock method and have carried out systematic relativistic calculations of DR cross sections and rate coefficients and resonant transfer and excitation cross sections in ion-atom collisions. In this paper, we will briefly discuss the relativistic calculations of atomic structure and transition rates and will focus for attention on the effects of relativity and intermediate coupling on the DR cross sections and rate coefficients. DOE

N92-25528# Technische Univ., Delft (Netherlands).
EFFECT OF CRYSTAL SIZE ON PHYSICAL AND CATALYTIC PROPERTIES OF ZSM-5 TYPE ZEOLITES Ph.D. Thesis
P. Voogd 30 Sep. 1991 192 p
(PB92-151034) Avail: NTIS HC/MF A09

Diffusion of C6-alkanes in zeolite ZSM-5 and its aluminum free variant silicate-1 receives the greatest attention in the thesis. A physical property of zeolite like the ability to sorb, in particular, nonpolar compounds, was utilized in studying hydrocarbon diffusion by performing adsorption and desorption experiments. The diffusional behavior of the zeolite ZSM-5 and of aluminated silicate-1 at catalytically relevant temperatures was studied by way of a catalytic property of the zeolite. Descriptions of physical studies on nitrogen sorption in ZSM 5 type zeolites and of catalytic studies on the conversion of ethanol to hydrocarbons complete the thesis which tries to give a better understanding of adsorptive, diffusional, and catalytic behavior by describing experiments in which only one parameter has been varied, the zeolite crystal size. Discussions and conclusions are directed towards the industrial application of zeolite ZSM-5, as a catalyst. GRA

N92-25744# Tufts Univ., Medford, MA. Electro-Optics Technology Center.
A MONOLITHIC THIN FILM ELECTROCHROMIC WINDOW
R. B. Goldner, F. O. Arntz, G. Berera, T. E. Haas, K. K. Wong, G. Wei, and P. C. Yu (PPG Industries, Inc., Monroeville, PA.) 1991 16 p Presented at the Solid State Ionics Conference, Lake Louise, Alberta, Oct. 1991
(Contract DE-FG03-85SF-15927)
(DE92-007706; CONF-9110331-1) Avail: NTIS HC/MF A03

Three closely related thin film solid state ionic devices that are potentially important for applications are: electrochromic smart windows, high energy density thin film rechargeable batteries, and thin film electrochemical sensors. Each usually has at least on mixed ion/electron conductor, an electron-blocking ion conductor, and an ion-blocking electron conductor, and many of the technical issues associated with thin film solid state ionics are common to all three devices. Since the electrochromic window has the added technical requirement of electrically-controlled optical modulation, (over the solar spectrum), and since research at the authors' institution has focused primarily on the window structure, this paper will address the electrochromic window, and particularly a monolithic variable reflectivity electrochromic window, as an illustrative example of some of the challenges and opportunities that are confronting the thin film solid state ionics community. DOE

N92-25751# Pennsylvania Univ., Philadelphia. Dept. of Physics.
CONDENSED MATTER PHYSICS AT SURFACES AND INTERFACES OF SOLIDS
E. J. Mele Jan. 1992 13 p
(Contract DE-FG02-84ER-45118)
(DE92-010032; DOE/ER-45118/7) Avail: NTIS HC/MF A03

This research program is focused on structural and elastic properties of crystalline solids and interfaces between solids. We are particularly interested in novel forms of structural ordering and the effects of this ordering on the lattice dynamical properties. We are currently studying structural and vibrational properties of the surfaces of the elemental alkaline earths (particularly Be), and structural phenomena in the doped fullerites. DOE

N92-25794# Brookhaven National Lab., Upton, NY.
THEORETICAL MODELS OF FLUX PINNING AND FLUX MOTION IN HIGH-Tc SUPERCONDUCTING OXIDES
D. O. Welch 1991 6 p Presented at the 2nd Tokai University International Workshop on Superconductivity, Honolulu, HI, 9-12 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-009372; BNL-47215; CONF-9110181-2) Avail: NTIS HC/MF A02

Various issues involved in the development of phenomenological models of flux pinning and motion in high-(Tc) oxides are discussed. A simplified model is presented for the critical current density and is used to examine the question of whether flux flow results from an instability due to plasticity of the flux-line array or from pin breaking. DOE

N92-25797# Missouri Univ., Rolla.
ELECTRONIC TRANSPORT AND MIXED CONDUCTIVITY IN PEROVSKITE TYPE OXIDES
H. U. Anderson, M. M. Nasrallah, D. M. Sparlin, and P. E. Parris 3 Mar. 1992 9 p
(Contract DE-FG02-85ER-45219)
(DE92-011223; DOE/ER-45219/6) Avail: NTIS HC/MF A02

The goal of the investigation presented in this report is to study the inter-relationship between electrical conductivity, oxidation-reduction kinetics, defect structure, and composition of n- and p-type binary and ternary transition metal oxides. The experimental part of the investigation included specimen preparation, thermogravimetric measurements, X-ray diffraction, thermally stimulated current, DTA/TGA, optical absorption,

transmission electron microscopy, electrical conductivity, and Seebeck measurements. The systems studied or being studied are LaMnO3-LaCrO3-LaCrO3, (La,Ca)(Mn,Al)O3, Y(1-x)Ca(x)CrO3, YMnO3-CaMnO3, and LaMnO3-CaMnO3. DOE

N92-25946# International Centre for Theoretical Physics, Trieste (Italy).
ON THE LONG-RANGE ORDER OF LIEB-MATTIS MODEL OF QUANTUM ANTIFERROMAGNET
I. G. Gochev and N. S. Tonchev (Bulgarian Academy of Sciences, Sofia.) Sep. 1991 6 p
(DE92-619539; IC-91/316) Avail: NTIS HC/MF A02

The spontaneous magnetization m and the root-mean-square order parameter m0 of the Lieb-Mattis model for arbitrary temperature and spin values s are obtained. For the ratio r(T,s) = m/m0 the value r(T,s) = the square root of 3 is found. DOE

N92-25947# National Inst. for Fusion Science, Nagoya (Japan).
TOTAL AND PARTIAL CROSS SECTIONS OF ELECTRON TRANSFER PROCESSES FOR Be(SUP Q+) AND B(SUP Q+) IONS IN COLLISIONS WITH H, H2, AND He GAS TARGETS
Hiro Tawara Jun. 1991 91 p
(DE92-768018; NIFS-Data-12) Avail: NTIS HC/MF A05

A review is given for the total and partial cross sections of electron transfer for Be(sup q+) and B(sup q+) ions in collisions with the important constituent targets in plasma devices such as H, H2, and He. A short comment on electron transfer data in relation to recent observations of photons from Be(sup q+) ions at JET tokamak is also given. DOE

N92-25988# California Univ., Los Angeles.
ENERGY RELATED STUDIES UTILIZING K-FELDSPAR THERMOCHRONOLOGY
1992 8 p
(Contract DE-FG03-89ER-14049)
(DE92-007469; DOE/ER-14049/3) Avail: NTIS HC/MF A02

In our second year of funding, we investigated the Ar diffusion properties and microstructures of K-feldspars and the application of domain theory to natural K-feldspars. We completed a combined TEM and argon diffusion study of the effect of laboratory heat treatment on the microstructure and kinetic properties of K-feldspar. We conclude in companion papers that, with one minor exception, no observable change in the diffusion behavior occurs during laboratory extraction procedures until significant fusion occurs at about 1100 C. The effect that is observed involves a correlation between the homogenization of cryptoperthite lamelle and the apparent increase in retentivity of about 5 percent of the argon in the K-feldspar under study. We can explain this effect of both as an artifact of the experiment or the loss of a diffusion boundary. Experiments are being considered to resolve this question. Refinements have been made to our experimental protocol that appear to enhance the retrieval of multi-activation energies from K-feldspars. We have applied the multi-domain model to a variety of natural environments (Valles Caldera, Red River fault, Appalachian basin) with some surprising results. Detailed Ar-40/Ar-39 coverage of the Red River shear zone, thought to be responsible for the accommodation of a significant fraction of the Indo-Asian convergence, strongly suggests that our technique can precisely date both the termination of ductile strike-slip motion and the initiation of normal faulting. Work has continued on improving our numerical codes for calculating thermal histories and the development of computer based graphing tools has significantly increased our productivity. DOE

N92-26038# Washington State Univ., Pullman. Dept. of Chemistry.
HOLE BURNING IN THE RESONANCE FLUORESCENCE OF IMPURITY CENTERS
Xinfu Xia, X. Li, D. L. Lin, and Thomas F. George Feb. 1992 19 p
(Contract N00014-90-J-1193)
(AD-A245811; WSU/DC/92/TR-78) Avail: NTIS HC/MF A03

The system of an impurity electron coupled to localized phonons is considered under the strong excitation of an external laser field. The resonance fluorescence spectrum is calculated for a two-level impurity atom. A hole and an antihole are found on the sidebands of the spectrum. Characteristic features of these novel structures are examined, and their physical origin is discussed. GRA

N92-26077# Innsbruck Univ. (Austria). Inst. of Experimental Physics.
INTRINSIC STRESS IN REACTIVELY MAGNETRON SPUTTERED METAL-NITRIDE/OXIDE FILMS Final Report, 1 Sep. 1990 - 31 Aug. 1991
H. K. Pulker and S. E. Rille 31 Aug. 1991 39 p
(Grant AF-AFOSR-0357-90)
(AD-A245848; EOARD-TR-92-02) Avail: NTIS HC/MF A03

Thin films deposited by physical vapor deposition (PVD) processes are generally in a state of mechanical stress, which can be regarded assumptionally as the sum of a external, thermal, and an intrinsic component. The external component can be neglected but a thermal component has to be considered, because of thermal input energies during film formation and possible differences in expansion between substrate and film material. The intrinsic component is understood to be the remaining structure sensitive part of the film stress. Therefore, the intrinsic mechanical stress represents a characteristic property of a film. Unpleasant macroscopic effects such as blisters in the case of compressive stress or cracks in the tensile case appear if the magnitude of the film stress exceeds either the adhesive force between film and substrate and/or the cohesive forces between film forming crystallites. GRA

N92-26161 Department of the Navy, Washington, DC.
SEMICONDUCTOR HETEROJUNCTION DEVICE WITH GRADED BANDGAP Patent
Tak-Kin Chu, inventor (to Navy) 29 Oct. 1991 4 p Filed 27 Apr. 1990 Supersedes AD-D014583
(AD-D015185; US-Patent-5,061,973; US-Patent-Appl-SN-517013; US-Patent-Class-357-16) Avail: US Patent and Trademark Office

The semiconductor materials of junction forming layers of a heterojunction structure are interfaced by a gap region that is graded by degree of alloying of those components of an interfacing material which are respectively compounded in the semiconductor materials of the junction forming layers having different bandgaps and band edges that are aligned by the grading of the interfacing gap region to selectively control rectifying junction characteristics. Author (GRA)

N92-26165# Stanford Linear Accelerator Center, CA.
OBSERVATION OF ELECTRON POLARIZATION ABOVE 80 PERCENT IN PHOTOEMISSION FROM STRAINED 3 TO 5 COMPOUNDS
E. L. Garwin, T. Maruyama, R. Prepost, and G. H. Zapalac Feb. 1992 7 p Presented at the Symposium on Surface Science 3S* 92, Savoie (France), 15-21 Mar. 1992
(Contracts DE-AC03-76SF-00515; DE-AC02-76ER-00881)
(DE92-009482; SU-SLAC-PUB-5751; CONF-9203100-1) Avail: NTIS HC/MF A02

Spin-polarized electron photoemission has been investigated for strained III--V compounds; (1) strained In(x)Ga(1-x)As epitaxially grown on a GaAs substrate, and (2) strained GaAs grown on a GaAs(1-x)P(x) buffer layer. The lattice mismatched heterostructure results in a highly strained epitaxial layer, and electron spin polarization as high as 90 pct. has been observed. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-25253# International Centre for Theoretical Physics, Trieste (Italy).
APPLICATION OF THE RENORMALIZATION GROUP TO DECAY OF THE FALSE VACUUM
H. A. Al-Kuwari (King Saud Univ., Riyadh, Saudi Arabia) and M. O. Taha Sep. 1991 7 p
(DE92-616924; IC-91/313) Avail: NTIS HC/MF A02

A renormalization group equation for the effective action of a massive scalar field theory is derived. It significantly restricts the dependence of the probability of decay of the false vacuum on the physical parameters. It is also remarkably useful for the implementation of a certain approximation of finite-temperature effects. Within this approximation one finds m(sub t) is approximately equal to 165 Gev if SU(2) x U(1) is broken by barrier penetration and the transition occurs when the probability is maximum. DOE

N92-25256# Florida Univ., Gainesville. Dept. of Physics.
REFORMULATING STRING THEORY WITH THE 1/N EXPANSION
C. B. Thorn 1991 7 p Presented at the First International A. D. Sakharov Conference on Physics, Moscow (USSR), 27-31 May 1991
(Contract DE-FG05-86ER-40272)
(DE92-008780; DOE/ER-40272/139; UFIFT-HEP-91-23; CONF-9105177-3) Avail: NTIS HC/MF A02

It is argued that string theory should have a formulation for which stability and causality are evident. Rather than regard strings as fundamental objects, it is suggested they should be regarded as composite systems of more fundamental point-like objects. A tentative scheme for such a reinterpretation is described along the lines of 't Hooft's 1/N expansion and the light-cone parametrization of the string. DOE

N92-25566 State Univ. of New York, Stony Brook.
COVARIANT QUANTIZATION OF SUPERSTRINGS Ph.D. Thesis
Machiko Tatewaki Hatsuda 1991 218 p
Avail: Univ. Microfilms Order No. DA9205272

The Dirac field was originally proposed to unify special relativity and quantum mechanics. However it contained a problem of negative energy states. Similarly, the superstring was introduced to unify gravity and quantum field theory with 'divergent free' (tachyon free) manner, while its fermionic part has kept away from practical quantum calculations. For the Dirac field, the hole interpretation of negative energy states, or equivalently the second quantization, resolved the problem. This suggests that the second quantization of superstrings may give some insight into the theory and help to resolve the difficulties. The purpose of this thesis is to examine the quantization of superstrings from the point of view of the BRST field theory, which is known to be successful in the case of bosonic strings. Two types of superstrings, namely Green-Schwarz (GS) superstring and Neveu-Schwarz-Ramond (NSR) superstring, are considered. GS superstring has 10-dimensional space-time supersymmetry while NSR superstring has 2-dimensional world-sheet supersymmetry. In GS superstring theory, the covariant first quantization is not known yet since problems arise from the fermionic constraints. We perform covariant BRST quantization of superparticle which is a zero-mode of GS superstring. The extension of our procedure to the superstring is not straightforward. We also analyze the modified superstring proposed by Siegel which has only first class constraints. It turned out that this modification was not enough for the consistent covariant quantization. Further modification was proposed by Siegel et al., which has auxiliary fields and new first class constraints. We perform covariant BRST quantization of Siegel's modified superparticle. Extension of this result to the superstring needs further study. The first quantization of NSR superstring is easy to carry out in a covariant way. By utilizing the 2-D superconformal field theory, I will analyze the phenomenology of the type II superstring to see whether it contains the standard model in the low energy limit. For the second quantization, difficulties arise from 'picture changing'. We propose a new model where these picture changing operators can be removed by nonminimal terms on the basis of the BRST field theory. The extension to the superstring is under study. Dissert. Abstr.

N92-25948# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
TOPOLOGICAL FIELD THEORY OF FOUR DIMENSIONAL SELF-DUAL GRAVITY AND TWISTED HARMONIC SUPERSPACE
Kei Ito Sep. 1991 12 p
(DE92-768072; INS-893) Avail: NTIS HC/MF A03

A topological invariant version of a self-interacting N=4 harmonic superfield model is constructed. It is shown that the theory describes the 'topological phase' of four dimensional self-dual gravity. DOE

N92-25970# Florida Univ., Gainesville. Inst. for Fundamental Theory.
A CLASSICAL THEORY OF CONTINUOUS SPIN AND HIDDEN GAUGE INVARIANCE
D. Zoller 1991 11 p
(Contract DE-FG05-86ER-40272)
(DE92-008777; DOE/ER-40272/126; UFIFT-HEP-91-7) Avail: NTIS HC/MF A03

We present a classical higher derivative point particle theory whose quantization gives Wigner's continuous spin representation of the Poincare group. Although the theory is not reparameterization invariant in the usual sense, it does possess a hidden gauge invariance that provides a non-local representation of the reparameterization group. The Hamiltonian of the theory does not vanish and its value is the continuous spin parameter. The theory presented here represents the simplest example of a wide class of higher derivative theories possessing a hidden gauge invariance. DOE

N92-25326*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE THEORY PANEL
Maha AshourAbdalla, Robert Rosner, Spiro Antiochos, Steven Curtis, B. Fejer, Christoph K. Goertz, Melvyn L. Goldstein, Thomas E. Holzer, J. R. Jokipii, and Lou-Chuang Lee (Alaska Univ., Fairbanks.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 85-99 Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge; and Johns Hopkins Univ., Baltimore, MD (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

N92-25655# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
EMPIRICAL DETERMINATION OF HEAT TRANSFER COEFFICIENTS
Martin Fiebig *In* VKI, Industrial Heat Exchangers 1991 38 p
(For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

N92-25656# Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluiddynamik.
NUMERICAL METHODS FOR CONVECTIVE HEAT TRANSFER
Martin Fiebig *In* VKI, Industrial Heat Exchangers 1991 64 p
(For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

N92-25658# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
NUMERICAL METHODS FOR THERMAL CALCULATIONS OF HEAT EXCHANGERS
P. Mercier *In* VKI, Industrial Heat Exchangers 1991 39 p (For primary document see N92-25651 16-31)
Copyright Avail: NTIS HC/MF A99

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N92-25786# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
INTERNATIONAL SPACE UNIVERSITY: EXPERIENCES AND OBSERVATIONS DURING SUMMER 1989 [INTERNATIONAL SPACE UNIVERSITY: KOKEMUKSIA JA HUOMIOITA KESAELTAE 1989]
Tero Siili *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 63-64 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N92-25204# RAND Corp., Santa Monica, CA. National Defense Research Inst.
WHEN SHOULD WE START HIGH-RATE PRODUCTION OF THE B-2? AN ANALYSIS BASED ON FLIGHT TEST RESULTS
Michael D. Rich and Giles K. Smith 26 Jul. 1991 24 p Sponsored by Office of the Secretary of Defense
(RAND/P-7757) Avail: NTIS HC/MF A03

In 1987, the Under Secretary of Defense for Acquisition requested that RAND conduct a study of the acquisition strategy of what was then known as the Advanced Technology Bomber. Initial results gave high marks to the risk reduction measures taken in the early phases of the program. However, considerable concern about the planned pace of the flight test program was expressed. Rand was asked to continue its analysis of the program's acquisition strategy. One of the questions tackled was how to tie production commitments to progress achieved in the test program, which was one of the original recommendations made in the preliminary study. This report describes the above continuing evaluation of the B-2 bomber program acquisition strategy. H.A.

N92-25511 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Cognitive Psychology Group.
HUMAN COGNITIVE PROCESSES IN COMMAND AND CONTROL PLANNING. 2: SPLITS: AN ENVIRONMENT FOR EXPERIMENTS Final Report [COGNITIEVE PROCESSEN IN COMMAND AND CONTROL PLANNING. 2: SPLITS: EEN OMGEVING VOOR EXPERIMENTEN]
Carol A. McCann (Defence and Civil Inst. of Environmental Medicine, North York, Ontario) and P. J. M. D. Essens 1 Aug. 1991 27 p Sponsored by TNO Defence Research
(IZF-1991-B-10; TD91-2170; ETN-92-91233) Copyright Avail: TNO Inst. for Perception, Kampweg 5, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

A laboratory based task and environment for empirical investigation of human planning of activities in time and space is described. The environment, called SPLITS, presents planners with problems analogous to those encountered in command and control environments. The problem situation against which planning is carried out is a computer based shopping game that can be played by one or two players. Aspects of the shopping environment, such as the layout of the store and its commodities and the number, mobility, and sensing capabilities of the shopping robots can be varied to give a range of planning task complexities. The use of SPLITS to address research issues such as the structure of human planning processes and the information used in planning the effects of uncertain information on planning the circumstances under which replanning occurs and how it is carried out, and the effects of computer based aids on the quality and efficiency of planning, is described. ESA

N92-25559*# National Aeronautics and Space Administration, Washington, DC.
GEORGE M. LOW TROPHY NASA'S QUALITY AND EXCELLENCE AWARD, 1992. APPLICATION GUIDELINES: LARGE BUSINESS
1992 33 p Prepared in cooperation with American Society for Quality Control, Milwaukee, WI
(NASA-TM-107835; NAS 1.15:107835; PB92-160738) Avail: NTIS HC/MF A03

The George M. Low Trophy is awarded to current NASA contractors, subcontractors, and suppliers in the aerospace industry who have demonstrated sustained excellence and outstanding achievements in quality and productivity for three or more years. The objectives of the award are to increase public awareness of the importance of quality and productivity to the Nation's aerospace program and industry in general; encourage domestic business to continue efforts to enhance quality, increase productivity, and thereby strengthen competitiveness; and provide the means for sharing the successful methods and techniques used by the applicants with other American enterprises. Information is given on candidate eligibility for large businesses, the selection process, the nomination letter, and the application report. Author

N92-25650*# Research Triangle Inst., Research Triangle Park, NC.
NASA TECHNOLOGY APPLICATIONS TEAM: APPLICATIONS OF AEROSPACE TECHNOLOGY Annual Report, Oct. 1988 - Sep. 1989
1989 157 p
(Contract NASw-4367)
(NASA-TM-101917; NAS 1.15:101917; RTI/4321/04-F) Avail: NTIS HC/MF A08

Two critical aspects of the Applications Engineering Program were especially successful: commercializing products of Application Projects; and leveraging NASA funds for projects by developing cofunding from industry and other agencies. Results are presented in the following areas: the excimer laser was commercialized for clearing plaque in the arteries of patients with coronary artery disease; the ultrasound burn depth analysis technology is to be licensed and commercialized; a phased commercialization plan was submitted to NASA for the intracranial pressure monitor; the Flexible Agricultural Robotics Manipulator System (FARMS) is making progress in the development of sensors and a customized end effector for a roboticized greenhouse operation; a dual robot are controller was improved; a multisensor urodynamic pressure catherer was successful in clinical tests; commercial applications were examined for diamond like carbon coatings; further work was done on the multichannel flow cytometer; progress on the liquid airpack for fire fighters; a wind energy conversion device was tested in a low speed wind tunnel; and the Space Shuttle Thermal Protection System was reviewed. Author

N92-25728*# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
COMPARISON OF DISPLAY ENHANCEMENT WITH INTELLIGENT DECISION-AIDING
Alex Kirlik, Wendy J. Markert, and Merrick Kossack 3 Feb. 1992 31 p
(Grant NAG2-656)
(NASA-CR-189895; NAS 1.26:189895) Avail: NTIS HC/MF A03

Currently, two main approaches exist for improving the human-machine interface component of a system in order to improve overall system performance, display enhancement and intelligent decision aiding. Each of these two approaches has its own set of advantages and disadvantages, as well as introduce its own set of additional performance problems. These

characteristics should help identify which types of problem situations and domains are better aided by which type of strategy. The characteristic issues are described of these two decision aiding strategies. Then differences in expert and novice decision making are described in order to help determine whether a particular strategy may be better for a particular type of user. Finally, research is outlined to compare and contrast the two technologies, as well as to examine the interaction effects introduced by the different skill levels and the different methods for training operators.
Author

N92-25737*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INTEGRATING PLANNING AND REACTION: A PRELIMINARY REPORT
John L. Bresina and Mark Drummond (Sterling Federal Systems, Inc., Moffett Field, CA.) Jan. 1990 8 p Submitted for publication Sponsored in part by AFOSR
(NASA-TM-107862; NASA-FIA-91-20; NAS 1.15:107862) Avail: NTIS HC/MF A02

The Entropy Reduction Engine architecture for integrating planning, scheduling, and control is examined. The architecture is motivated through a NASA mission scenario and a brief list of design goals. An overview is presented of the Entropy Reduction Engine architecture by describing its major components, their interactions, and the way in which these interacting components satisfy the design goals. Author

N92-25246# National Committee for Technological Development, Budapest (Hungary).
POLICY FOR HARMONISING AND OPTIMISING FACILITIES IN THE HUNGARIAN R AND D SECTOR
Erno Pungor *In* ESA, EURISY Symposium on the Earth's Environment: An Assessment from Space Oct. 1991 p 125-127 (For primary document see N92-25226 16-45)
Copyright Avail: NTIS HC/MF A07

N92-25725*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA SURFACE-MODELING AND GRID-GENERATION (SM/GG) ACTIVITIES
Yung K. Choo *In its* Workshop on Grid Generation and Related Areas Apr. 1992 p 143-149 (For primary document see N92-25712 16-07)
Avail: NTIS HC/MF A08

N92-25785# Kauppa-ja Teollisuusministerio, Helsinki (Finland). Avaruusasiain Neuvottelukunta.
TASKS OF THE COUNCIL AND GENERAL SECRETARY OF THE COMMISSION FOR SPACE INDUSTRY (FINLAND) [AVARUUSASIAIN NEUVOTTELUKUNNAN JA PAEAESIHTEERIN TEHTAEVAET]
Haakan Sandell *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 61-62 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-25149*# Research Inst. for Computing and Information Systems, Houston, TX.
THEORETICAL FOUNDATIONS FOR INFORMATION REPRESENTATION AND CONSTRAINT SPECIFICATION
Christopher P. Menzel and Richard J. Mayer 5 Mar. 1991 68 p Prepared in cooperation with Texas A&M Univ., College Station
(Contract NCC9-16; RICIS Proj. IM-06)
(NASA-CR-190286; NAS 1.26:190286) Avail: NTIS HC/MF A04

Research accomplished at the Knowledge Based Systems Laboratory of the Department of Industrial Engineering at Texas A&M University is described. Outlined here are the theoretical foundations necessary to construct a Neutral Information Representation Scheme (NIRS), which will allow for automated data transfer and translation between model languages, procedural programming languages, database languages, transaction and process languages, and knowledge representation and reasoning control languages for information system specification. Author

N92-25183# Technische Univ., Delft (Netherlands).
MODELLING SUPPORT IN INFORMATION SYSTEMS DEVELOPMENT Ph.D. Thesis
Gerardus Maria Wijers 1991 257 p
(ISBN-90-5170-110-1; ETN-92-91289) Avail: NTIS HC/MF A12

Computer Assisted Systems Engineering (CASE) tools and methods are considered, mainly as tools offering partial methodical structure to 'information engineers' in the 'practical problem solving process' of effectively applying information technology to persons and organizations. An approach and environment enabling effective individual modeling (not managerial) support, based on a detailed understanding of their way of working and modeling, is presented. The following subjects are addressed: modeling support; information systems development; representation of model knowledge; acquisition of modeling knowledge; experiments on D2S2, Yourdon and ESM (Evolutionary Systems Methodology); detailed understanding of modeling; development of an MSS (Modeling Support Systems) environment. ESA

N92-25184 Politecnico di Milano (Italy). Dipartimento di Elettronica.
A DECLARATIVE APPROACH TO ACTIVE DATABASES
Stefano Ceri Jan. 1992 8 p
(Rept-92-007; ETN-92-91367) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A general description of the field of active data bases is given. The work is focused on the main problems to be solved: the understanding of the semantics of a collection of production rules; and the programming of production rules. It is suggested that deductive databases may contribute to understanding some of the these problems. The classes of applications that can be specified in a declarative way are indicated. Significant progress was achieved both in the research environment and in the commercial world. This behavior is supported through integrated, low level prodution rule facilities allowing for the automatic execution of data manipulation operations when certain events occur and/or certain conditions are met. In spite of the rapid development of this field, several problems remain to be solved in order for active databases to become widespread and fully accepted. ESA

N92-25214# Westinghouse Savannah River Co., Aiken, SC.
ADVANCED SCIENTIFIC COMPUTING ENVIRONMENT TEAM NEW SCIENTIFIC DATABASE MANAGEMENT TASK
J. P. Church, J. C. Roberts, R. N. Sims, A. O. Smetana, and B. W. Westmoreland Jun. 1991 28 p
(Contract DE-AC09-89SR-18035)
(DE92-009653; WSRC-TR-91-420) Avail: NTIS HC/MF A03

The mission of the ASCENT Team is to continually keep pace with, evaluate, and select emerging computing technologies to define and implement prototypic scientific environments that maximize the ability of scientists and engineers to manage scientific data. These environments are to be implemented in a manner consistent with the site computing architecture and standards and NRTSC/SCS strategic plans for scientific computing. The major trends in computing hardware and software technology clearly indicate that the future 'computer' will be a network environment that comprises supercomputers, graphics boxes, mainframes, clusters, workstations, terminals, and microcomputers. This 'network computer' will have an architecturally transparent

operating system allowing the applications code to run on any box supplying the required computing resources. The environment will include a distributed database and database managing system(s) that permits use of relational, hierarchical, object oriented, GIS, et al, databases. To reach this goal requires a stepwise progression from the present assemblage of monolithic applications codes running on disparate hardware platforms and operating systems. The first steps include converting from the existing JOSHUA system to a new J80 system that complies with modern language standards, development of a new J90 prototype to provide JOSHUA capabilities on Unix platforms, development of portable graphics tools to greatly facilitate preparation of input and interpretation of output; and extension of 'Jvv' concepts and capabilities to distributed and/or parallel computing environments.
DOE

N92-25298*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE SCIENCE LABORATORY PUBLICATIONS AND PRESENTATIONS, 1 JANUARY - 31 DECEMBER 1991
Tauna W. Moorehead Apr. 1992 57 p
(NASA-TM-103566; NAS 1.15:103566) Avail: NTIS HC/MF A04

Listed here are significant publications and presentations of the Space Science Laboratory during the period January 1 to December 31, 1991. Entries are categorized according to NASA Reports (arranged by report number), Open Literature, and Presentations (arranged alphabetically by title). Also included is an appendix listing preprints issued by the laboratory during this reporting period.
Author

N92-25360 Politecnico di Milano (Italy). Dipartimento di Elettronica.
STATIC TYPE CHECKING OF OBJECT-ORIENTED DATABASES
Alberto Coen-Porisini, Luigi Lavazza (Master School CEFRIEL, Milan, Italy), and Roberto Zicari Nov. 1991 28 p Sponsored in part by CNR
(Rept-91-060; ETN-92-91253) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

In this paper, we will address the hard problem of ensuring type safeness for the specific class of object oriented database systems supporting 'typed' data, 'static type checking', 'late bending' and 'subtype polymorphism' with 'covariance condition'. The statistical type checking of these systems by defining a data flow technique which detects all possible type errors and gives sufficient conditions for ensuring type safeness is shown. The algorithms which make use of such data flow technique together with some simple examples are presented. The results presented can provide the basis of the implementation of a consistency checker to ensure the 'behavioral consistency' of an object oriented database system after a 'schema update' has been performed.
ESA

N92-25509# RAND Corp., Santa Monica, CA.
GAUGING THE INFORMATION REVOLUTION
Bryan Ellickson 1991 53 p Sponsored by Alfred P. Sloan Foundation
(RAND/N-3351-SF) Avail: NTIS HC/MF A04

This paper examines the way that information technologies might be affecting the geographical location of economic activity both in the United States and abroad. It is an assessment of the evolution in information processing over the past 40 years. A basic hypothesis of the overall project is that new and low cost information services are reducing the need for face to face interaction, thereby encouraging the decentralization of economic activity, for example, from metropolitan to rural areas. This note serves to set the stage for that analysis by placing the changes in information technology in broad historical perspective. The analysis presented draws upon extensive efforts at data collection as well as a synthesis of a wide range of studies appearing in the computer science and economics literature.
H.A.

N92-25548 Syracuse Univ., NY.
AN EXAMINATION OF SITUATIONAL DIMENSIONS IN THE INFORMATION BEHAVIORS OF GENERAL MANAGERS Ph.D. Thesis
Patricia Tobaka Fletcher 1991 392 p
Avail: Univ. Microfilms Order No. DA9204503

The focus here is on user-defined descriptions of situational dimensions. These situational dimensions include, but are broader than dimensions such as subject matter. The respondents were 26 upper-level managers in both the public and private sectors. The situational dimensions were grouped into three components: part of the problem, part of the outcome, and part of the process, with most of the situational dimensions (55.1 percent) occurring as part of the problem. An interesting finding was the emergence of the interpersonal/emotional dimension, a characteristic suggested in the literature as being important to information behaviors.
Dissert. Abstr.

N92-25551# Executive Office of the President, Washington, DC.
PUBLICATIONS OF THE EXECUTIVE OFFICE OF THE PRESIDENT, JANUARY 20, 1989 TO DECEMBER 31, 1991
Dec. 1991 14 p
(PB92-127661) Avail: NTIS HC/MF A03

A list is presented of the publications of the Executive Office of the President for the Bush Administration for the period of 20 Jan. 1989 to 31 Dec. 1991. Listed are the publications released by the following groups: the Council of Economic Advisors; the Council on Environmental Quality; the Office of Administration; the Office of Management and Budget; the President's Council on Integrity and Efficiency; the Office of National Drug Control Policy; the Office of Science and Technology Policy; the Office of the United States Trade Representative; the Office of the Vice President; the National Space Council; and the White House Office.
GRA

N92-25560 Carnegie-Mellon Univ., Pittsburgh, PA.
ELECTRONIC DISSEMINATION OF SCHOLARLY JOURNALS: AN ECONOMIC AND TECHNICAL ANALYSIS Ph.D. Thesis
Walter Paul Zahray 1990 146 p
Avail: Univ. Microfilms Order No. DA9126972

Presented here is a model of the scholarly information market that identifies the economic relationships between four key actors: publishers, intermediaries, libraries, and users. Electronic dissemination systems are classified by architecture in a way that simplifies the universe of possible systems, yet retains sufficient technical and organizational detail to compare their effectiveness in supporting intellectual property compensation and the delivery of documents. Analysis based on this model identifies combinations of architectures and pricing structures that have the potential to improve the welfare of all actors involved. Illustrative parameter values are presented and used to provide insights into the viability of different electronic library implementations, and to identify key parameters which warrant further investigation.
Dissert. Abstr.

N92-25604 Texas Univ., Austin.
A FORMAL, UNIFIED MODELING FRAMEWORK: KNOWLEDGE REPRESENTATION AND AUTOMATED REASONING Ph.D. Thesis
Sa Neung Hong 1991 137 p
Avail: Univ. Microfilms Order No. DA9200641

This research proposes a formal, unified modeling framework combining the advantages of logic and mathematical modeling based on model theory and measurement theory. We take clear semantics and general inferencing techniques from logic modeling, and computational convenience and efficiency from mathematical modeling. In the framework, domain worlds are clearly separated mathematical systems and the two are explicitly connected by homomorphisms. The framework supports deductive reasoning, mathematical computations, and specialized solver systems.
Dissert. Abstr.

N92-25643# California Univ., Berkeley. Lawrence Berkeley Lab.
DATA MANIPULATION IN HETEROGENEOUS DATABASES
A. Chatterjee and A. Segev Oct. 1991 5 p
(Contract DE-AC03-76SF-00098)
(DE92-009510; LBL-30870) Avail: NTIS HC/MF A01

Many important information systems applications require access to data stored in multiple heterogeneous databases. This paper examines a problem in inter-database data manipulation within a heterogeneous environment, where conventional techniques are no longer useful. To solve the problem, a broader definition for join operator is proposed. Also, a method to probabilistically estimate the accuracy of the join is discussed. DOE

N92-25799*# Illinois Univ., Urbana. Center for Reliable and High-Performance Computing.
DATABASE RECOVERY USING REDUNDANT DISK ARRAYS
Antoine N. Mourad, W. K. Fuchs, and Daniel G. Saab Feb. 1992 8 p
(Contract NAG1-613; N00014-91-J-1283)
(NASA-CR-190382; NAS 1.26:190382; AD-A245581) Avail: NTIS HC/MF A02

Redundant disk arrays provide a way for achieving rapid recovery from media failures with a relatively low storage cost for large scale database systems requiring high availability. In this paper we propose a method for using redundant disk arrays to support rapid recovery from system crashes and transaction aborts in addition to their role in providing media failure recovery. A twin page scheme is used to store the parity information in the array so that the time for transaction commit processing is not degraded. Using an analytical model, we show that the proposed method achieves a significant increase in the throughput of database systems using redundant disk arrays by reducing the number of recovery operations needed to maintain the consistency of the database. GRA

N92-25800# Naval Postgraduate School, Monterey, CA.
DESIGN AND IMPLEMENTATION OF VISUAL INTERFACE TO DATABASE M.S. Thesis
Suprapto Sep. 1991 126 p
(AD-A245589) Avail: NTIS HC/MF A07

Traditional approaches to database system design and implementation involve text-oriented data access with their inherent lack of modularity, extensibility, and modifiability. An alternative to this traditional approach is using visual interface for the design and implementation of databases. This alternative approach involves using software development tools (toolkits) to ensure modularity, extensibility, and modifiability. To study the effectiveness of using visual interfaces, we have designed and implemented a sample application using KnowledgePro (Windows), a tool for rapid application development under Windows. GRA

N92-25802# ARC Professional Service Group, Inc., Rome, NY.
CATHODE LIFE PREDICTION Final Report, Aug. 1990 - Aug. 1991
Ronald Jardieu and Robert Macior Dec. 1991 65 p
(Contract F30602-89-D-0028)
(AD-A245697; RL-TR-91-321) Avail: NTIS HC/MF A04

This report describes the operational characteristics and measurement procedures associated with the Cathode Life Test Facility. The facility was designed to perform periodic emission testing on various types of thermionic cathode emitters operating under simulated life test conditions. Established calibration procedures are outlined and recently measurement and operating temperature determination techniques are discussed, as well as additional formats for data presentation and analysis. The software source code for the life test temperature is also provided. A method to facilitate recognition and differentiation between computer data files is described and comprehensive inventory documentation including pertinent data log sheets are presented. GRA

N92-26021# Defence Research Establishment, Ottawa (Ontario).
INTRODUCING THE DREO ELINT BROWSER UTILITY (DEBU)
B. Ford and D. Jones Jul. 1991 35 p
(AD-A245325; DREO-TN-91-7) Avail: NTIS HC/MF A03

DREO developed an Elint database browsing tool, called DEBU, that allows Elint databases, such as Kilting, EWIR, and AFEWC, to be easily reviewed and analyzed from a PC workstation. DEBU's basic function is to allow a user to examine the contents of user-selected subfiles of user-selected emitters of user-selected databases. DEBU augments this functionality with support for selecting (filtering) and combining subsets of emitters by user-selected attributes such as ELNOT, name, parameter type, or parameter value. DEBU provides access to facilities for examining histograms and x-y plots of selected parameters as well as the generation and printing of a variety of reports. With its multiple windows, pop-up menus, and help support, DEBU is easy to use. GRA

N92-26079# Naval Postgraduate School, Monterey, CA.
INTERNAL CONTROL IN AN EDI ENVIRONMENT M.S. Thesis
Dal H. Bae Dec. 1991 84 p
(AD-A245869) Avail: NTIS HC/MF A05

Electronic Data Interchange (EDI) is the electronic transmission of standard business documents in machine-readable format between parent companies and respective trading partners. As the use of EDI has grown, there have been the associated risks due to an uncontrolled environment. Accordingly, the necessity for effective internal controls in an EDI environment is on the rise. This thesis evaluates and analyzes the feasible internal controls in an EDI environment and provides recommendations for further development. It discusses the basic concepts of EDI, general control, and application control issues, as well as legal issues related to an EDI environment. Author (GRA)

N92-26109*# National Aeronautics and Space Administration, Washington, DC.
OAST SPACE TECHNOLOGY ACCOMPLISHMENTS FY 1991 Final Report
Apr. 1992 173 p
(NASA-TM-4369; NAS 1.15:4369) Avail: NTIS HC/MF A08

The program consists of a continuum of space research and technology activities ranging from initial research to the full scale test of prototype equipment in space. Activities include work that is performed by in-house staff at the NASA Centers, university researchers supported by NASA funded grants and contracts, and industrial aerospace organizations under contract to NASA. These diverse activities provide advances in technology breakthroughs that may revolutionalize a technical discipline or mission concept. The work is managed and coordinated by OAST through a process that integrates the best available talent and capability in NASA, industry, and universities into a National civil space research and technology program. Author

N92-26134# RAND Corp., Santa Monica, CA.
ELECTRONIC INFORMATION MEDIA AND RECORDS MANAGEMENT METHODS: A SURVEY OF PRACTICES IN UNITED NATIONS ORGANIZATIONS
Tora K. Bikson and Sally Ann Law 1991 39 p Repr. from ACCIS Electronic Information Media and Records Management Methods Survey, 17-20 Sep. 1991
(RAND-N-3453-RC) Avail: NTIS HC/MF A03

The rapid and widespread diffusion of electronic information and communication media has presented significant challenges for archives and records management in United Nations organizations, as documented in a 1990 ACCIS publication. The report indicated that traditional practices devised primarily to handle paper-based record material are not readily extended to these new media. It therefore recommended that United National organizations develop policies and procedures directly applicable to record material in electronic form, in order both to manage active electronic material more effectively and to secure its long-term preservation for legal and historic purposes. In support

of those aims, ACCIS convened a Working Group on Electronic Records Management Issues and Standards (WG/ERMIS). Understanding the kinds of practices emerging within United Nations organizations as the use of electronic information and communication technologies grows was one of its tasks. The survey reported here was undertaken for that purpose. It updates what was learned from a similar survey carried out in 1988, whose findings are described in the ACCIS Guidelines. Author

N92-26138# Physics and Electronics Lab. TNO, The Hague (Netherlands).
DATA FUSION: TEMPORAL REASONING AND TRUTH MAINTENANCE Final Report
A. P. Kenne and M. Perre Nov. 1991 100 p In ENGLISH and DUTCH
(AD-A245600; FEL-91-B308; TDCK-TD91-3885) Avail: NTIS HC/MF A05

This report contains a survey of two techniques that can be used in the field of data fusion: temporal reasoning and truth maintenance. The automatic fusion of intelligence reports necessitates taking into account the factor time. Incoming messages can lead to new interpretations of the current battlefield situation, changing previously made hypotheses. A data fusion system must also be able to make a prediction of what sightings are to be expected, e.g., in the case of columns of vehicles moving past different sensors. This report describes a temporal database system that can capture (some part) of the volatility of the intelligence processing domain. While processing intelligence reports there is always an amount of uncertainty and incompleteness that has to be dealt with. So there is a need for maintaining different lines of reasoning or hypotheses pertaining to the battlefield situation concurrently, and incorporating new information as it becomes available. In this report an assumption-based truth maintenance system provides a framework in which this problem can be solved. A prototype has been developed to demonstrate the applicability of the aforementioned techniques. This prototype, called Mefisto (Modular Environment for Fusion and Interpretation of Sensor data in Tracking Opposing forces), is a simple knowledge-based system integrated with in temporal truth maintenance facility. GRA

N92-25787# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
SPACE ELECTRONIC DISPLAY PANEL [AVARUUSALAN ELEKTRONINEN ILMOITUSTAULU]
Tero Siili *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 65-66 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N92-25439# Committee of the Whole House on the State of the Union (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MULTIYEAR AUTHORIZATION ACT OF 1992
George E. Brown, Jr. Washington GPO 22 Apr. 1992 36 p A bill on H.R. 4364 committed to the Committee of the Whole House on the State of the Union, 102d Congress, 2d Session, 22 Apr. 1992
(H-Rept-102-500) Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

This report, submitted by the House Committee on Science, Space, and Technology reviews bill (H.R. 4364) to authorize appropriations to NASA for research and development, space flight, control and data communications, construction of facilities, and research program management. H.A.

N92-25554# Committee on Science, Space and Technology (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MULTIYEAR AUTHORIZATION ACT OF 1992
George E. Brown, Jr. Washington GPO 22 Apr. 1992 92 p Report to accompany H.R. 4364 presented by the Committee on Science, Space, and Technology, 102d Congress, 2d Session, 22 Apr. 1992
(H-Rept-102-500; GPO-54-553) Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

The committee on Science, Space, and Technology, to whom was referred the bill (H.R. 4364) to authorize appropriations to NASA for research and development, space flight, control and data communications, construction of facilities, research and program management, and Inspector General, and for other purposes, having considered the same, report favorably thereon with an amendment and recommend that the bill, as amended, do pass. H.A.

N92-25606# Committee on Commerce, Science, and Transportation (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1993
Albert Gore, Jr. Washington GPO 9 Apr. 1992 12 p S. 2558 enacted into law by the 102d Congress, 2d Session, 9 Apr. 1992
(S-2558-IS) Avail: Document Room, Senate, Washington, DC 20510 HC free

The bill is presented which was presented to the 102nd congress to authorized appropriations to NASA for research and development, space flight, control and data communications, construction of facilities, and research and program management, and Inspector General, and for other purposes. The bill has been read twice and referred to the Committee on Commerce, Science, and Transportation. Author

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-25380*# Research Triangle Inst., Research Triangle Park, NC.
NASA TECHNOLOGY APPLICATIONS TEAM. APPLICATIONS OF AEROSPACE TECHNOLOGY Annual Report, Oct. 1990 - Sep. 1991
1991 206 p
(Contract NASw-4367)
(NASA-CR-189483; NAS 1.26:189483; RTI/4321/12-F) Avail: NTIS HC/MF A10

Discussed here are the activities of the Research Triangle Institute (RTI) Technology Applications Team for the period 1 October 1990 through 30 September 1991. Topics researched include automated data acquisition and analysis of highway pavement cracking, thermal insulation for refrigerators, the containment of paint removed from steel structures, improved

technologies for Kuwait oil well control, sprayed zinc coatings for corrosion control of reinforcing steel in bridges, and the monitoring and life support of medically fragile children in the educational setting. Author

N92-25395*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPARISON OF GLIMPS AND HFAST STIRLING ENGINE CODE PREDICTIONS WITH EXPERIMENTAL DATA
Steven M. Geng and Roy C. Tew 1992 8 p Proposed for presentation at the 27th Intersociety Energy Conversion Engineering Conference, San Diego, CA, 3-7 Aug. 1992; sponsored by SAE, ACS, AIAA, ASME, IEEE, AIChE, and ANS
(NASA-TM-105549; E-7078; NAS 1.15:105549) Avail: NTIS HC/MF A02

Predictions from GLIMPS and HFAST design codes are compared with experimental data for the RE-1000 and SPRE free piston Stirling engines. Engine performance and available power loss predictions are compared. Differences exist between GLIMPS and HFAST loss predictions. Both codes require engine specific calibration to bring predictions and experimental data into agreement. Author

N92-25500# Westover Consultants, Inc., Washington, DC.
SUMMARY OF PROCEEDINGS, NATIONAL SCIENCE FOUNDATION: JAPANESE TECHNOLOGY EVALUATION CENTER WORKSHOP
1991 62 p Workshop held in Washington, DC, 13 May 1991 Sponsored in part by NSF
(PB92-100643) Avail: NTIS HC/MF A04

An overview is given of the Japanese Technology Evaluation Center (JTEC) program. Topics covered include the U.S. - Japan science and technology agreement, technology transfer, National Science Foundation international activities, the U.S. - Japan Industry and Technology Management Training Program, Department of Defense needs for technology assessments, JTEC information dissemination, and a discussion of future directions. Author

88 SPACE SCIENCES (GENERAL)

N92-25321*# National Aeronautics and Space Administration, Washington, DC.
SPACE PHYSICS STRATEGY-IMPLEMENTATION STUDY. VOLUME 1: GOALS, OBJECTIVES, STRATEGY. A REPORT TO THE SPACE PHYSICS SUBCOMMITTEE OF THE SPACE SCIENCE AND APPLICATIONS ADVISORY COMMITTEE
Apr. 1991 153 p Original contains color illustrations
(NASA-TM-105500; NAS 1.15:105500; PB92-106624) Avail: NTIS HC/MF A08; 18 functional color pages

Space physics is defined as the study of the heliosphere as one system; that is, of the Sun and solar wind, and their interactions with the upper atmospheres, ionospheres, and magnetospheres of the planets and comets, with energetic particles, and with the interstellar medium. This report contains a number of reports by different panels on the major topics in the space physics program including: (1) the cosmic and heliospheric physics program for the years 1995 to 2010; (2) ionosphere, thermosphere, and mesosphere studies; (3) magnetospheric physics; (4) solar physics; and (5) space physics theory. For individual titles, see N92-25322 through N92-25326.

N92-25322*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE COSMIC AND HELIOSPHERIC PANEL c90
Richard A. Mewaldt, Glenn M. Mason, Aaron Barnes, W. Robert Binns, Leonard F. Burlaga, Michael L. Cherry, Thomas E. Holzer, J. R. Jokipii (Arizona Univ., Tucson.), Vernon Jones, and James C. Ling et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 15-37 Prepared in cooperation with JPL; California Inst. of Tech., Pasadena; Chicago Univ., IL; and Michigan Univ. Original contains color illustrations (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

The Cosmic and Heliospheric Branch proposes a bold new program for the years 1995 to 2010 that is centered on the following two themes: (1) the global heliosphere and interstellar space; and (2) cosmic particle acceleration and the evolution of matter. Within these major themes are more specific goals that have been studied and continue to be examined for a better understanding of their processes. These include: origin, structure, and evolution of the solar wind; interaction of the heliosphere, the solar wind, and the interstellar medium; fundamental microscopic and macroscopic plasma processes; acceleration and transport of energetic particles; and the origin and evolution of matter. Finally, the report summarizes a wide variety of proposed small and large space missions. H.A.

N92-25323*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE IONOSPHERE-THERMOSPHERE-MESOSPHERE PANEL c90
Edward P. Szuszczewicz, Tim L. Killeen, Roger L. Arnoldy, Larry H. Brace, Andrew B. Christensen, B. Fejer, Roderick A. Heelis, Michael J. Keskinen, Nelson C. Maynard, and Hans G. Mayr (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 39-48 Prepared in cooperation with Johns Hopkins Univ., Laurel, MD; and National Center for Atmospheric Research, Boulder, CO. Original contains color illustrations (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

The scientific objectives and mission concept that emerged from the discussions of this panel are presented. The overall scientific theme of this report is the investigation of the ionosphere, thermosphere, and mesosphere (near Earth space environment) as a global, dynamic, and coupled system. Among the specific goals of this area of research are: (1) understanding the consequences of transition between turbulent and laminar flow and collisional and collisionless media; (2) understanding the thermospheric/mesospheric coupling due to gravity wave, tidal, and trace constituent transport processes; (3) understanding the electrodynamical coupling between the thermosphere/ionosphere and magnetosphere; (4) understanding the coupling processes between small scale plasma structures; and (5) determining the real-time evolution of the global ionosphere electric field in response to solar wind and magnetosphere coupling. H.A.

N92-25324*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE MAGNETOSPHERIC PHYSICS PANEL c90
James L. Burch, Thomas A. Potemra, Maha AshourAbdalla, Daniel N. Baker, Cynthia A. Cattell, Andrew F. Chang, Louis A. Frank, Christoph K. Goertz, Margaret G. Kivelson, and Lou-Chuang Lee (Alaska Univ., Fairbanks.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 49-66 Prepared in cooperation with Rice Univ., Houston, TX; and Lockheed Missiles and Space Co., Palo Alto, CA Original contains color illustrations (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

Magnetospheric research is a relatively new area in the study of the Earth's environment. The present report attempts to overview past and future research on this topic. The goals of magnetospheric research are numerous, and include: understanding large scale magnetospheres of the Earth and other planets; understanding the plasma physical processes operating within the various

magnetospheres; to understand how mass, energy and momentum are transmitted from the solar wind; to understand quantitatively the coupling between magnetospheres and their ionospheres; and to understand the magnetospheric mechanisms which accelerate particles to high energies, as well as the ultimate fate of these particles. The report continues on to summarize a number of proposed space missions aimed at data acquisition. Finally, there is a brief discussion of the theory and modeling of magnetospheres. H.A.

N92-25325*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE SOLAR PHYSICS PANEL c92
George L. Withbroe, Richard R. Fisher, Spiro Antiochos, Guenter Brueckner, J. Todd Hoeksema, Hugh Hudson, Ronald Moore, Richard R. Radick, Gary Rottman, and Philip Scherrer (Stanford Univ., CA.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 67-83 Prepared in cooperation with NASA. Goddard Space Flight Center, Greenbelt, MD; Lockheed Missiles and Space Co., Palo Alto, CA; and California Inst. of Tech., Pasadena, Big Bear Solar Observatory (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

Recent accomplishments in solar physics can be grouped by the three regions of the Sun: the solar interior, the surface, and the exterior. The future scientific problems and areas of interest involve: generation of magnetic activity cycle, energy storage and release, solar activity, solar wind and solar interaction. Finally, the report discusses a number of future space mission concepts including: High Energy Solar Physics Mission, Global Solar Mission, Space Exploration Initiative, Solar Probe Mission, Solar Variability Explorer, Janus, as well as solar physics on Space Station Freedom. H.A.

N92-25326*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE THEORY PANEL c77
Maha AshourAbdalla, Robert Rosner, Spiro Antiochos, Steven Curtis, B. Fejer, Christoph K. Goertz, Melvyn L. Goldstein, Thomas E. Holzer, J. R. Jokipii, and Lou-Chuang Lee (Alaska Univ., Fairbanks.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 85-99 Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge; and Johns Hopkins Univ., Baltimore, MD (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

The ultimate goal of this research is to develop an understanding which is sufficiently comprehensive to allow realistic predictions of the behavior of the physical systems. Theory has a central role to play in the quest for this understanding. The level of theoretical description is dependent on three constraints: (1) the available computer hardware may limit both the number and the size of physical processes the model system can describe; (2) the fact that some natural systems may only be described in a statistical manner; and (3) the fact that some natural systems may be observable only through remote sensing which is intrinsically limited by spatial resolution and line of sight integration. From this the report discusses present accomplishments and future goals of theoretical space physics. Finally, the development and use of new supercomputer is examined. H.A.

N92-25758# Oulu Univ. (Finland). Dept. of Physics.
SECOND MEETING OF FINNISH SPACE RESEARCHERS [2. SUOMEN AVARUUSTUTKIJOIDEN KOKOUS]
Pekka Tanskanen, comp. and Jouko Raitala, comp. 1990 77 p In ENGLISH and FINNISH Meeting held in Oulu, Finland, 5-6 Oct. 1989
(Rept-117(1990); ISBN-951-42-2903-7; ISSN-0356-1852; ETN-91-99900) Avail: NTIS HC/MF A05

The activities of the Finnish space science and technology community are reviewed. Finnish participation in space programs including spacecraft and ground instrumentation is covered. Societies, industries, universities, and organizations involved in space sciences and the Finnish Air Museum are mentioned. For individual titles, see N92-25759 through N92-25793.

N92-25759# Outokumpu Oy Electronics, Espoo (Finland).
SPECTRUM-X-GAMMA: GAS FILLED POSITION SENSITIVE COUNTERS c19
Tor Andersson, Panu Jalas, M. Maaspuro, Seppo Nenonen, and H. Sipilae *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 1-2 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Two position sensitive proportional counters for the Soviet-Danish Roentgen Telescope (SODART), the x-ray telescope on board the Soviet Spectrum-X-gamma satellite, are described. Their energetic ranges will be 0.5 to 3.0 keV and 2.0 to 17.0 keV. The development of an ultrathin entrance window and a gas supply system was required to make the detectors sensitive to such soft x-rays. A multilayer plastic x-ray window was developed using thin film technology. The two detector boxes are placed in the focal plane of the telescope and are designed to enable the use of 150 mm windows and anode plates. The volume is about 1 liter. The anode is a slightly conductive mineral glass plate on which thin gold wires are etched using photolithography technique. The gas supply is electronically controlled. ESA

N92-25760# Helsinki Univ. of Technology, Espoo (Finland). Avaruustekniikan Lab.
ESA AND TKK (FINLAND) REMOTE SENSING PROGRAMS [EUROOPAN AVARUUSJAERJESTOEN JA TEKNILLISEN KORKEAKOULUN KAUKOKARTOITUSOHJELMAT] c43
Martti T. Hallikainen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 3-5 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

ESA programs, including the Earth Resources Satellite-1 (ERS-1) and TKK studies in remote sensing, are outlined. A laboratory for microwave detection (Finland) is discussed. Some envisaged projects are outlined. An 8-track radar for airborne study of forests, a radiometric technique for detection of microwaves over snow and forests, and a method to detect ozone in the atmosphere are discussed. Additionally, the use of radiometric microwave measurements by the American Nimbus 7 satellite for studies on snow, ice at sea, forest mapping, and wind velocity are discussed. International project involvement is outlined. ESA

N92-25761# Suomen Ilmailumuseo, Vantaa (Finland).
AIR MUSEUM [SUOMEN ILMAILUMUSEO]
Boerje Hielm *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 6 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Aspects of the air museum at Vantaa (Finland) are described. The second exhibition hall was inaugurated in 1989 and houses a permanent space activity exhibition. ESA

N92-25762# Suomen Ilmailumuseo, Vantaa (Finland).
SOCIETY OF SPACE STUDIES Abstract Only [SUOMEN AVARUUSTUTKIMUSSEURA]
Boerje Hielm *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 7 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The society, which has functioned since 1959 as a liaison between professionals and amateurs in the space sciences field, and with other similar foreign societies, is described. Its objective is to promote space sciences amongst members and the public at large. ESA

N92-25763# Oulu Univ. (Finland). Dept. of Physics.
SOLAR CYCLE EFFECTS ON MAGNETOSPHERIC ION-CYCLOTRON WAVE ACTIVITY Abstract Only **c92**
Jorma Kangas, Kalevi Mursula, Tapani Pikkarainen, and Tapani Rinne *In its* Second Meeting of Finnish Space Researchers 1990 p 9 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The use of long term records of geophysical phenomena in studying the magnetospheric response to solar activity over the solar cycle period is discussed. The analysis of geomagnetic pulsation data recorded at Sodankyla (Finland) during one solar cycle extending from 1974-1985 is reported. Both Pc1 and Intervals of Pulsations of Diminishing Pulsations (IPDP) type pulsations appear to be less frequent in the years of high solar activity than in years of low activity. A new observation is the long term variation of the frequency of occurrence of IPDP plasma wave events. The variation is related to changes in plasmapause location, attenuation of waves in the ionospheric waveguide, and heavy ion composition during the 11 year solar cycle. Special attention is given to evaluating the role of the changes in plasma composition in the magnetosphere. ESA

N92-25764# Oulu Univ. (Finland). Taehtitieteen Laitos.
ALBA PATERA: EVOLUTIONARY PHASES OF A MARTIAN VOLCANO [ALBA PATERA: TULIVUOREN KEHITYSVAIHEITA MARSISSA] **c91**
Kauko Kauhanen *In its* Second Meeting of Finnish Space Researchers 1990 p 11-12 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Alba Patera is among the most ancient of Martian volcanoes. Alba Patera is nearly 2 billion earth years old. Studies carried out on it are discussed. ESA

N92-25765# Technical Research Centre of Finland, Espoo. Instrumenttitekniikan Lab.
SPACE RESEARCH AT THE TECHNICAL RESEARCH CENTRE OF FINLAND (VTT) [VTT:N AVARUUSTUTKIMUS]
Vaeinoe Kelhae *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 13-14 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The Technical Research Center of Finland (VTT) performs research in satellite communication, remote sensing, and space techniques and instruments. Its objectives are space-related development in industry, promotion of applications, and instruments for space research. Several programs are discussed: TELE-X satellite, Aspera (plasma analyzer on Phobos), solar panel technologies, telecommunications and remote sensing with ESA and USSR, participation in the Finnish Energetic and Relativistic Nuclear Electron (ERNE)-CEPAC energetic particle analyzer, French and Finnish ERNE-SWAN project flying on the Solar and Heliospheric Observatory (SOHO) to measure solar wind anisotropy, GOMOS (Global Ozone Monitor), and the Silicon X-ray Array (SIXA) detector for the Soviet Spectrum-X satellite. ESA

N92-25766# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
GLOBAL OZONE MONITORING BY OCCULTATION OF STARS (GOMOS) **c45**
Seppo Korpela, Erkki Kyroelae, Risto Pellinen, Tapio Tuomi, Ville Sipinen, Vaeinoe Kelhae, Gilbert Leppelmeier, Kai Maekisara, Heikki Saari, and Kai Haemaelaeinen (Hollming Oy Elektroniikka, Tampere, Finland) et al *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 15-16 In FINNISH; ENGLISH title (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The Global Ozone Monitoring by Occultation of Stars (GOMOS) instrument suggested for the polar platform is outlined. GOMOS was suggested by CNRS (France), the Finnish Meteorology Institute, and the Besancon Observatory. Italian, German, and Norwegian assistance is outlined. ESA

N92-25767# Helsinki Univ. of Technology, Espoo (Finland). Ilmatieteen Laitos.
PERSPECTIVES ON RESEARCH AND EDUCATION OF SPACE PLASMA PHYSICS [AVARUUSPLASMAFYSIIKAN TUTKIMUS: JA KOULUTUSNAEKYMISTAE SUOMESSA] **c75**
Hannu Koskinen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 17-19 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Aspects of the long tradition of Finnish research into space plasma physics are outlined. The development of the Aspera instrument (a plasma analyzer of Phobos), manufactured by Sweden and Finland, is viewed as an important achievement. The Aspera instrument was flown onboard a Soviet Phobos spacecraft for the purpose of making plasma measurements. Finnish contributions to several international programs, including Cluster, the Energetic and Relativistic Nuclear and Electron (ERNE) particle analyzer, the European Incoherent Scatter Radar (EISCAT) system, and the Scandinavian Twin Auroral Radar Experiment (STARE) are recalled. ESA

N92-25768# Oulu Univ. (Finland). Dept. of Physics.
ION COMPOSITION IN THE MAGNETOSPHERE: RECENT OBSERVATIONS OF ENERGETIC He(+) AND He(++) IONS BY AMPTE/CCE **c46**
Gerhard Kremser *In its* Second Meeting of Finnish Space Researchers 1990 p 21-22 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The use of measurements from the Charge Energy Mass (CHEM) spectrometer on the Active Mesospheric Particle Tracer Explorer (AMPTE)/Charge Composition Explorer (CCE) satellite to investigate the average spatial distributions of He(+) and He(++) ions in the magnetosphere is reported. The analysis is based on 46 months of data obtained close to the equatorial plane when the apogee of the satellite rotated three times through all local times. Analyses of the L profiles are given. At L greater than or equal to 7, the distribution of He(+) ions is determined by drift characteristics only, whereas the He(++) ion distribution is considerably influenced by convection from the tail. This result indicates that the solar wind originated He(++) ions reach the inner magnetosphere via the tail, whereas the He(+) ion originating in the ionosphere may reach the magnetosphere directly. In respect to this it is noted that the density maximum of He(+) ions is located on L shells corresponding to the auroral zone. ESA

N92-25769# Oulu Univ. (Finland). Fysiikan Laitos ja Konetekniikan Osasto.
WORK EXPERIENCES ON THE DESIGN OF THE CLUSTER SATELLITE [KOKEMUKSIA CLUSTER-SATELLIITEN DESIGN-TYOESTAE] **c18**
Kauko Lappalainen *In its* Second Meeting of Finnish Space Researchers 1990 p 23-24 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Finnish participation in the Cluster project is described. The University of Oulu (Finland) cooperated with the University of California Space Sciences Laboratory in Berkeley (U.S.) for the design and manufacturing of the EFW (Electric Fields and Waves) instrument destined for launch on Ariane 5 in 1995. ESA

N92-25770# Oulu Univ. (Finland). Dept. of Mechanical Engineering.
THE EFW EXPERIMENT FOR THE CLUSTER SATELLITE PROGRAM **c46**
Kauko Lappalainen, Kalevi Mursula, Jorma Pulkkinen, Reijo Rasinkangas, and Pekka Tanskanen *In its* Second Meeting of Finnish Space Researchers 1990 p 25 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The EFW (Electric Fields and Waves) experiment onboard the four identical Cluster satellites is summarized. The purpose of the experiment is to measure EFW and the density of the near Earth

and solar wind plasma. Four identical boom boxes are to be mounted in a square configuration with a common electronics box. The EFW will give the two components of the electric field in the spinning plane. The DC field amplitude covers the range from 0.1 to 500 mV/m. Electric waves can be resolved in the frequency range from 50 mHz to several hundred Hz with a sensitivity of at least 50 nV/m/square root of Hz. ESA

N92-25771# Helsinki Univ. of Technology, Espoo (Finland). Teoreettisen Fysiikan Laitos.
RADAR MEASUREMENT OPTIMIZATION [TUTKAMITTAUSTEN OPTIMOINTI] **c32**
Markku S. Lehtinen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 27-28 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Inversion theory and the study and applications of European Incoherent Scatter Radar (EISCAT) measurement optimization theory are discussed. An 'alternating code' theory, which gives results approaching optimal precision, is discussed. The developed theories are extremely important tools for space research application. ESA

N92-25772# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
FINNISH PARTICIPATION IN THE SOVIET MARS PROGRAM [SUOMEN OSALLISTUMINEN NEUVOSTOLIITON MARS-OHJELMAAN]
Ilkka Liede *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 29-30 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Two planned projects for spaceflight to Mars are the U.S. Mars observer and the Soviet Mars-94 mission. Finnish participation in the Phobos mission includes the Aspera plasma spectrometer, the LIMA-D test laser to measure the consistence of elements of the Phobos moon, the DION test, the VSK-FREGAT camera, and the spectrometer system. Discussions of future applications (Mars-94) include the Aspera C plasma spectrometer, the camera system, spectrometer, and SPICAM monitor. ESA

N92-25773# Helsinki Univ. of Technology, Espoo (Finland). Observatory.
TV IMAGING OF PHOBOS, VSK (VIDEOSPECTROMETRIC COMPLEX) EXPERIMENT **c91**
Kari Lumme *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 31-32 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The VSK experiment on the Phobos spacecraft, which consisted of a three-channel television camera, a spectrometer, and a memory unit that had a 1.5 Gbit capacity, is described. A total of 37 images, including 13 high resolution images covering most of Phobos' surface except the sub Mars region, were used in concert with Mariner 9 and Viking data to update the spherical harmonics model of Phobos' shape, to provide improved determinations of its density and orbital dynamics, and to study its surface color, composition, and texture. Data analysis methods included a radiative transfer theory for a stochastically rough surface. This theory yields information both about the small dust particles forming the regolith and the roughness of the surface. The disk integrated brightness was fitted to this theory. Phobos was shown to exhibit a striking difference in brightness between green and infrared colors. Two statistical photoclinometric methods, based on the distribution of shadowed pixels and the correlation of surface brightness, were developed and provided information on the surface topography in the statistical sense. ESA

N92-25774# Helsinki Univ. of Technology, Espoo (Finland). Observatory and Astrophysics Lab.
STATISTICAL TOPOGRAPHY OF PHOBOS Abstract Only **c91**
Karri Muinonen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 33 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Two statistical photoclinometric methods were developed to recover information on the small scale topography of an atmosphereless solar system body. The methods are applicable if the area under consideration does not exhibit dominating features such as large hills or craters, but shows clearly defined shadowed portions (shadow method) or variations in the surface brightness (brightness method). The shadow method is independent of any albedo variations on the illuminated fraction of the surface. On the other hand, when the scattering law is well known and the amount of shadows on the surface is negligible, the brightness method can be utilized to recover the surface statistics. The statistical methods are especially meant for studies where the detailed reconstruction of the surface is not nescessarily needed. Both methods were verified through numerical simulations of Gaussian surfaces. Preliminary results were obtained for the statistical topography of Phobos using the brightness method. On the investigated parts of Phobos' surface the standard deviation of slopes, the standard deviation of heights and the correlation length are of the order of 0.2, 10 m, and 50 m, respectively.
ESA

N92-25775# Technical Research Centre of Finland, Espoo. Instrumenttitekniikan Lab.
CONSTRUCTION AND EXPLOITATION OF NEW REMOTE SENSING INSTRUMENTS [UUSIEN KAUKOKARTOITUSINSTRUMENTTIEN RAKENTAMINEN JA KAEYTTOE] **c19**
Kai Maekisara *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 35-36 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Finnish investigations into the construction of near future instruments, descriptive and programmable, are outlined. The following instruments are discussed: the Medium Resolution Imaging Spectrometer (MERIS) and the High Resolution Imaging Spectrometer (HRIS) of the Polar Platform; lidar (light and detection ranging); the Earth Resources Satellite-1 (ERS-1) and Radarsat synthetic aperture radar; and the Advanced Microwave Sounding Unit-A (AMSU-A) and the Advanced Microwave Sounding Unit-B (AMSU-B) Polar Platform microwave instruments. ESA

N92-25776# Oulu Univ. (Finland). Fysiikan Laitos.
EISCAT RESEARCH IN FINLAND [EISCAT-TUTKIMUS SUOMESSA] **c32**
Tuomo Nygren *In its* Second Meeting of Finnish Space Researchers 1990 p 37-38 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Finnish work on the EISCAT (European Incoherent Scatter) Scientific Association is outlined. Finland participated in the AD reception/transformer system and the Barker decoder and filters for the quadrature indicator. Radar theory, analysis, and modulation methods were developed. Finland prepared common and specialized measurement programs. International cooperation, particularly with Leicester University (United Kingdom) and the Max Planck Institute (Germany, F.R.), is outlined. The coherent radar (COSCAT) is placed at the University of Oulu (Finland). Measurements were carried out jointly with American radar (Millstone Hill and Sondre Stomfjord). ESA

N92-25777# Helsinki Univ. of Technology, Espoo (Finland). Ilmatieteen Laitos.
INSTITUTE OF METEOROLOGY SPACE STUDIES PROGRAM [ILMATIETEEN LAITOKSEN AVARUUSTUTKIMUSOHJELMA] **c91**
Risto Pellinen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 39-41 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Details of the Finnish meteorology institute are given. Program

participation includes the following: three studies in the Phobos program; the LIMA-D program; and research in the field of magnetospheric physics and space plasma on the basis of existing measurements. Other studies are for instruments for the Interball program. The following instruments are discussed: SWAN for the Solar and Heliospheric Observer (SOHO); the Energetic and Relativistic Nuclear and Electron (ERNE) particle detector for SOHO; modernization of the Scandinavian Twin Auroral Radar Experiment (STARE) radar; the Goddard Earth Model (GEM) radar for Polar Platform; participation on GOMOS (Global Ozone Monitoring); examination of METEGG meteorological stations; Phase A2 for the Soviet Mars-94 program; and an instrument similar to the Cassini-Huygens program for ESA and NASA. ESA

N92-25778# Oulu Univ. (Finland). Taehtitieteen Laitos.
PLANETARY GEOLOGY: TECTONICS OF TERRESTRIAL PLANETS AND OF THE MOON [PLANEETTAGEOLOGIA: TERRESTRISTEN PLANEETTOJEN JA KUUN TEKTONIIKKA] **c91**
Jouko Raitala *In its* Second Meeting of Finnish Space Researchers 1990 p 43-44 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Research on Venus, using documents obtained by the Venera 15/16 radar, is outlined. Research on Mars using Viking documents, in preparation for the Mars Observer program, is discussed. Research on the Moon and Mercury is addressed. Remote sensing of planets is considered. ESA

N92-25779# Oulu Univ. (Finland). Taehtitieteen Laitos.
REMOTE SENSING OF WATER REGIONS IN NORTHERN FINLAND [POHJOIS-SUOMEN VESIALUEIDEN KAUKOKARTOITUSTA] **c43**
Jouko Raitala *In its* Second Meeting of Finnish Space Researchers 1990 p 45-47 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

A report of remote sensing results from a study of satellite imagery of water regions in Finland is presented. The regions are between the lake Kemijarvi and the bank of the island of Hailuoto. ESA

N92-25780# Geophysical Observatory, Sodankyla (Finland).
MAGNETOMETRY USED IN ROCKET TESTS [MAGNETOMETRI RAKETTIKOKEISSA] **c15**
Aarne Ranta, J. Kultima, Heikki Ranta, M. Alatalo, and F. Primdahl (Danish Space Research Inst., Lyngby.) *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 49-50 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The NOON CUSP-1 test was launched by a NASA rocket from Andenes (Norway). Finnish development of the magnetometer and a sensor sleeve is discussed. Future Finnish participation is discussed in the context of the following missions: a rocket launch (with NASA) in 1991, from Andenes, is possible; and the MIRE (Magnet Interaction Rocket Experiment) program is to be developed in conjunction with the Massachusetts Institute of Technology, with a possible launch from NASA's Wallops Island (U.S.). ESA

N92-25781# Hollming Oy Elektroniikka, Tampere (Finland).
PARTICIPATION OF FINNISH COMPANIES IN SPACE STUDIES [TEOLLISUUSYRITYKSEN OSALLISTUMINEN AVARUUSTUTKIMUKSEEN] **c19**
Heikki Rautonen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 51-52 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

A study of the possibilities for Finnish industrial participation in the development and creation of instruments and equipment for space research is presented. Space projects of the Hollming Oy Elektroniikka company are considered. The following subjects are listed: instrument power sources, terrestrial equipment, and surface instruments. ESA

N92-25782# Helsinki Univ. of Technology, Espoo (Finland). Radiolab.
MILLIMETER WAVE TECHNOLOGY IN SPACE [MILLIMETRIAALTOTEKNIIKKAA AVARUUTEEN] **c89**
Antti Raeisaenen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 53-54 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The development and study of millimeter wave technology for space applications (in ESA projects) is discussed. Examples of Finnish and Soviet cooperation, in the area of space studies, are presented. Particular projects include: development of critical detection technologies for spaceborne submillimeter heterodyne receivers; and Finnish participation in equipment destined for the Soviet satellite Radioastron. ESA

N92-25783# Oulu Univ. (Finland). Dept. of Astronomy.
SIMULATIONS OF SELF-GRAVITATING SYSTEMS **c90**
Heikki Salo (Helsinki Univ. of Technology, Espoo, Finland), Jyrki Lukkari, and Jyrki Haenninen *In its* Second Meeting of Finnish Space Researchers 1990 p 55-57 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Particle simulation methods for research into numerical studies of planetary ring dynamics, especially the interaction between satellites and narrow ringlets, and detailed studies of the galaxy-galaxy interactions are discussed. Most of the programs have been vectorized from IBM mainframe applications and ported to the Cray X-MP. Although the studies could be described as a kind of experimental celestial mechanics and stellar dynamics, the driving force behind theoretical modeling lies on modern observations, such as from the Voyager spacecraft. The main motivation for the study of galaxy-galaxy interactions lies in the comparison of numerical models with actual observations. The actual observations will be performed with the recently finished Nordic Optical Telescope. ESA

N92-25784# Helsinki Univ. of Technology, Espoo (Finland). Radiolab.
RESEARCH PROJECTS ON SATELLITE TELECOMMUNICATION AT THE TKK (FINLAND) [SATELLIITTITIETOLIIKENTEEN TUTKIMUSPROJEKTIT TKK:SSA] **c32**
Erkki Salonen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 59-60 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Radio-frequency propagation-detecting signals, emitted by the Olympus satellite, are reviewed. Finnish research is carried out at the Metsaehovi, a Kirkkonummi (Finland) station, in parallel with ten European countries and the U.S. The Finnish method for the study of propagation phenomena for low availabilities, requested by ESA, is presented. ESA

N92-25785# Kauppa-ja Teollisuusministerio, Helsinki (Finland). Avaruusasiain Neuvottelukunta.
TASKS OF THE COUNCIL AND GENERAL SECRETARY OF THE COMMISSION FOR SPACE INDUSTRY (FINLAND) [AVARUUSASIAIN NEUVOTTELUKUNNAN JA PAEAESIHTEERIN TEHTAEVAET] **c81**
Haakan Sandell *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 61-62 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The work of the Commission is outlined. The organizational, financial, and administrative distribution of this organization is discussed. The organization is under the control of the ministry of commerce and industry and is regulated by the decree of February 1989. ESA

N92-25786# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
INTERNATIONAL SPACE UNIVERSITY: EXPERIENCES AND OBSERVATIONS DURING SUMMER 1989 [INTERNATIONAL SPACE UNIVERSITY: KOKEMUKSIA JA HUOMIOITA KESAELTAE 1989] **c80**
Tero Siili *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 63-64 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

An account of the activities of the International Space University (ISU) is given. Observations from the Summer of 1989 at the Louis Pasteur University, Strasbourg (France), are given. ESA

N92-25787# Helsinki Univ. of Technology, Espoo (Finland). Geofysiikan Osasto.
SPACE ELECTRONIC DISPLAY PANEL [AVARUUSALAN ELEKTRONINEN ILMOITUSTAULU] **c82**
Tero Siili *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 65-66 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The AVAR-EI, which is a 'space electronic display panel', is discussed in terms of its engineering. The display panel was designed under the guidance of the Finnish Institute of Meteorology. ESA

N92-25788# Oulu Univ. (Finland). Dept. of Physics.
SPACE SCIENCE AND TECHNOLOGY FOR THE FUTURE
Pekka Tanskanen *In its* Second Meeting of Finnish Space Researchers 1990 p 67-68 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The physics of magnetized plasma systems is discussed. Additionally, the ESA Cluster satellite program, designed primarily to study small scale structures in the Earth's plasma environment, is outlined. The program is composed of four spacecraft to be placed in non-coplanar polar orbits in which the relative distances between the satellites can be changed according to their position in space. Small scale space plasma parameters, of fundamental importance in determining the interaction processes occurring between plasma of different characteristics, will be studied. The RAPID (Research with Adaptive Particle Imaging Detectors) and EFW (Electric Fields and Waves) instruments are discussed. The Cluster launch is planned for 1995 on Ariane 5. ESA

N92-25789# Turku Univ. (Finland). Avaruustutkimus Lab.
SOLAR PRODUCTION OF NEUTRONS [AURINGON NEUTRONITUOTTO] **c92**
Jarmo Torsti *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 69 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The theory of the solar production of neutrons presented by Professor Ludwig Biermann in 1951 and confirmed thirty years later is discussed. The study is part of specific objectives of the Energetic and Relativistic Nuclear and Electron (ERNE) project using the HED detector. ESA

N92-25790# Oulu Univ. (Finland). Taehtitieteen Laitos.
AN EVENTUAL HOT SPOT MARK ON VENUS [MAHDOLLINEN HOT SPOT: JAELKI VENUKSELLA] **c91**
Terhi Toermaenen and Jouko Raitala *In its* Second Meeting of Finnish Space Researchers 1990 p 71-72 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The solar or ovoidal crowns on Venus, found by radar images from Venera 15/16, are described. A comparison with the Earth volcano chain between Hawaii and Midway (U.S.) is made and scientific conclusions are drawn. ESA

N92-25791# Helsinki Univ. of Technology, Espoo (Finland). Metsaehovin Radiotutkimusasema.
FINNISH PARTICIPATION IN THE RADIOASTRON PROGRAM [SUOMEN OSALLISTUMINEN RADIOASTRON-OHJELMAAN] **c89**
Esko Valtaoja (Turku Univ., Finland) *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 73-74 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

Finland is taking part, with ten other countries, in the Soviet Radioastron 1 program. Radioastron 1 is to be launched in 1994. Finland will help construct part of the equipment and will provide ground based support. Finland is a member of the management of Radioastron (RISC) and its Scientific Objectives Committee. A newly proposed study is participation in the VLBI (Very Long Base Interferometry) satellite (IVS/International VLBI Satellite). A study to evaluate the feasibility of Finnish participation in the Japanese VSOP project (the Japanese equivalent of VLBI) is discussed. ESA

N92-25792# Helsinki Univ. of Technology, Espoo (Finland). Observatory and Astrophysics Lab.
SOLID STATE SPECTROMETER ARRAY ON BOARD SPECTRUM-X-GAMMA **c19**
Osmi Vilhu *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 75-76 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

The solid spectrometer array for the Soviet Spectrum-X-gamma satellite is discussed. The mission objectives include broad and narrow band imaging spectroscopy and timing over a wide range of energies from Extreme Ultraviolet (EUV) to gamma rays with emphasis on the studies of galactic and extragalactic x-ray sources. Moderate resolution spectroscopy and timing will be accomplished using the segmented Silicon X-ray Array/Solid State Spectrometer Array (SIXA/SSSA) and images will be recorded by Position Sensitive Proportional Counters (PSPC). Finance for Finnish participation in SIXA and PSPC is discussed. ESA

N92-25793# Helsinki Univ. of Technology, Espoo (Finland). Observatory and Astrophysics Lab.
SINGLE AEROSOL PARTICLE SCATTERING PROFILE MEASURING TECHNIQUES BY PICOBALANCE, MODIFIED MILLIKAN'S CHAMBER **c74**
Sampo Ylaetalo and Kari Lumme *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 77 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

On the basis of theoretical investigations concerning light scattering from a single particle, and to satisfy the need for verification, the aim is to build and calibrate an apparatus to catch a single dust particle for light scattering measurements. In the experiments the intensities of incident and scattered light as well as the polarization properties are to be measured as a function of scattering angle. The detection system consists of picobalance, a goniometer, a laser light source, and a photodiode detector. The picobalance, developed from Millikan's chamber, is a commonly known aerosol measurement device for the particle size range of 0.1 to 100 microns. In the picobalance chamber there are two spherical and two ring shaped electrodes. Spherical electrodes are used for the levitation of the aerosol particle under investigation. The ring electrodes focus the particle in the laser beam at the middle of the chamber. The goniometer is used for rotating the detector horizontally around the particle in order to perform polarization and intensity measurements. The device is operated electronically by an AC power supply and uses sensors to start and stop the measurement. The laser light source is an ordinary He-Ne laser that is stabilized against relative intensity fluctuations over 0.15. The apparatus is still under development, but a single particle has levitated in a stable state for hours and the first results considering intensity measurements for spherical particles will soon be ready for analysis. ESA

N92-25953*# Alabama Univ., Huntsville. Dept. of Physics.
HARD X RAY IMAGING GRAPHICS DEVELOPMENT AND LITERATURE SEARCH Final Report, Jun. 1990 - Jun. 1991
A. Gordon Emslie 1991 17 p
(Contract NAS8-36955)
(NASA-CR-184277; NAS 1.26:184277) Avail: NTIS HC/MF A03

This report presents work performed between June 1990 and June 1991 and has the following objectives: (1) a comprehensive literature search of imaging technology and coded aperture imaging as well as relevant topics relating to solar flares; (2) an analysis of random number generators; and (3) programming simulation models of hard x ray telescopes. All programs are compatible with NASA/MSFC Space Science LAboratory VAX Cluster and are written in VAX FORTRAN and VAX IDL (Interactive Data Language). H.A.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-25177# Royal Observatory, Edinburgh (Scotland).
UNITED KINGDOM INFRARED TELESCOPE Annual Report, 1990
1990 57 p Prepared in cooperation with Joint Astronomy Centre, Hilo, HI
Avail: NTIS HC/MF A04

The 1990 annual report on the United Kingdom Infrared Telescope (UKIRT) in Mauna Kea, Hawaii is given. Information is given on the historical development and instrumentation. Scientific studies are briefly noted. Studies include the abundance of AsH3 in Jupiter, the exciting star in G35.2N, a K-band deep galaxy survey, and high spectral resolution observations of fluorescent molecular hydrogen in molecular clouds. An operations report is given covering such areas as telescope usage and performance, instrument status, computing services, an upgrade of UKIRT image quality, and instrumentation development. Author

N92-25332*# Rutgers - The State Univ., Piscataway, NJ. Dept. of Physics and Astronomy.
ULTRAVIOLET PROPERTIES OF INDIVIDUAL HOT STARS IN GLOBULAR CLUSTER CORES. 1: NGC 1904 (M 79) Semiannual Status Report
Bruce Altner (Applied Research Corp., Landover, MD.) and Terry A. Matilsky 11 May 1992 40 p
(Grant NAG5-1750)
(NASA-CR-190297; NAS 1.26:190297) Avail: NTIS HC/MF A03

As part of an observing program using the International Ultraviolet Explorer (IUE) satellite to investigate the ultraviolet properties of stars found within the cores of galactic globular clusters with blue horizontal branches (HBs), we obtained three spectra of the cluster NGC 1904 (M 79). All three were long integration-time, short-wavelength (SWP) spectra obtained at the so called 'center of light' and all three showed evidence of sources within the IUE large aperture (21.4 in. by 10 in.). In this paper we shall describe the analysis of these spectra and present evidence that the UV sources represent individual hot stars in the post-HB stage of evolution. Author

N92-25710 Arizona Univ., Tucson.
A NEW MID-INFRARED CAMERA FOR GROUND-BASED ASTRONOMY AND AN INFRARED STUDY OF PLANETARY NEBULAE Ph.D. Thesis
Joseph Lee Hora 1991 401 p
Avail: Univ. Microfilms Order No. DA9210322

This dissertation is composed of two parts. The first part is a description of the Mid-Infrared Array Camera (MIRAC), a new camera for ground-based astronomy. The second part of this dissertation is an infrared study of planetary nebulae utilizing observations with the new camera. MIRAC is a collaborative effort among the University of Arizona, Smithsonian Astrophysical Observatory, and Naval Research Laboratory. It currently utilizes a Hughes 20 x 64 Si:As Impurity Band Conduction (IBC) detector array, which is sensitive to infrared (IR) radiation from 2 to 26 microns. The camera is equipped with 10 percent bandwidth filters at 2.2, 3.8, 4.6, 8.8, 9.8, 11.7, and 12.5 microns, and a wide band 8.0 to 12.8 micron 'N' filter. There is also a 20 percent filter a 20.5 microns, and a 8-14 micron Circular Variable Filter (CVF) with a resolution of 1.8 percent. The MIRAC electronics provides timing signals and coadds successive frames at a maximum rate of 10 KHz for the full array, and higher rates for a partial array readout. The data are transferred via a serial interface to a PC for storage and further processing. The camera recently achieved a Noise Equivalent Flux Density (NEFD) of.010 Jy/arcsec(exp 2) at 8.8, 11.7, and 12.5 microns for a 900 second on-source integration on the Steward Observatory 1.5 m telescope. Dissert. Abstr.

N92-25711 Pittsburgh Univ., PA.
AN INVESTIGATION OF H I-SELECTED QSO ABSORPTION SYSTEMS WITH LARGE REDSHIFTS Ph.D. Thesis
Limin Lu 1991 318 p
Avail: Univ. Microfilms Order No. DA9209404

Five separate investigations are conducted to study the Ly(alpha) forest clouds and the damped Ly(alpha) systems detected in the spectra of high redshift quasi stellar objects (QSOs). The redshift distribution of the Ly(alpha) forest clouds and the inverse/proximity effect are studied using a large, homogeneous data set. We confirm the existence of the 'inverse effect' with two mutually independent samples. The data are found to be consistent with a model in which the inverse effect is due to the enhanced ionization of Ly(alpha) clouds by the nearby QSOs. We find J(sub v) is approximately equal to 10(exp -21.0 +- 0.5) ergs cm(exp -2) s(exp -1) sr(exp -1) at z = (1.7,3.8) from the model. When the proximity effect is taken into consideration, the redshift index of evolution is found to be gamma = 2.75 +/- 0.29. Alternative explanations for the inverse effect are discussed. A search for CIV 1548,1550 absorption associated with Ly(alpha) forest clouds is attempted, using a composite-spectrum method. A tentative detection of CIV 1548 absorption is made at greater than 99.99 percent significance level. If confirmed, not all Ly(alpha) forest clouds are primordial. Assuming the detection is real, the relative abundance of carbon is estimated to be (C/H) is approximately equal to -3. A survey for candidate damped Ly(alpha) absorption is conducted, using 51 QSO spectra obtained at low resolution. A total of 41 candidates are detected at a completeness level of N(HI) is greater than or equal to 2 x 10(exp 20) cm(exp -2). Intermediate-resolution spectra of 9 QSOs, containing 15 candidate damped Ly(alpha) absorption features, are obtained. Rigorous test criteria are developed, and are applied to the candidates to determine their nature. Curve-of-growth analysis is performed to derive effective velocity dispersions for the confirmed damped systems. Dissert. Abstr.

N92-25736*# California Univ., San Diego, La Jolla.
OPTIMAL EXTRACTION OF QUASAR LYMAN LIMIT ABSORPTION SYSTEMS FROM THE IUE ARCHIVE Final Report
David Tytler 10 May 1992 7 p
(Grant NAG5-1317)
(NASA-CR-190335; NAS 1.26:190335) Avail: NTIS HC/MF A02

The IUE archive contains a wealth of information on Lyman limit absorption systems (LLS) in quasar spectra. QSO spectra from the IUE data base were optimally extracted, coadded, and analyzed to yield a homogeneous samples of LLS at low red shifts. This sample comprise 36 LLS, twice the number previously analyzed low z samples. These systems are ideal for the determination of the origin, redshift evolution, ionization, velocity dispersions and the metal abundances of absorption systems. Two of them are also excellent targets for the primordial Deuterium to Hydrogen ratio. Author

N92-25669*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADAR RECONNAISSANCE OF NEAR-EARTH ASTEROIDS

S. J. Ostro *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 9-13 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25670*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OBSERVATIONS OF SPACE DEBRIS AT GOLDSTONE (CALIFORNIA)
R. M. Goldstein and L. W. Randolph *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 15-18 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25782# Helsinki Univ. of Technology, Espoo (Finland). Radiolab.
MILLIMETER WAVE TECHNOLOGY IN SPACE [MILLIMETRIAALTOTEKNIIKKAA AVARUUTEEN]
Antti Raeisaenen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 53-54 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25791# Helsinki Univ. of Technology, Espoo (Finland). Metsaehovin Radiotutkimusasema.
FINNISH PARTICIPATION IN THE RADIOASTRON PROGRAM [SUOMEN OSALLISTUMINEN RADIOASTRON-OHJELMAAN]
Esko Valtaoja (Turku Univ., Finland) *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 73-74 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N92-25163*# Fermi National Accelerator Lab., Batavia, IL.
LET'S GO: EARLY UNIVERSE 2. PRIMORDIAL NUCLEOSYNTHESIS THE COMPUTER WAY
Lawrence Kawano (California Inst. of Tech., Pasadena.) Jan. 1992 58 p
(Grants NAGw-2381; NSF PHY-90-13248)
(NASA-CR-190118; NAS 1.26:190118; FERMILAB-Pub-92/04-A)
Avail: NTIS HC/MF A04

This is a revised description and manual for the primordial nucleosynthesis program, NUC123, an updated and modified version of the code of R.V. Wagoner. NUC123 has undergone a number of changes, further enhancing its documentation and ease of use. Presented here is a guide to its use, followed by a series of appendices containing specific details such as a summary of the basic structure of the program, a description of the computational algorithm, and a presentation of the theory incorporated into the program. Author

N92-25318# International Centre for Theoretical Physics, Trieste (Italy).
HIGHER DERIVATIVES AND RENORMALIZATION IN QUANTUM COSMOLOGY
F. D. Mazzitelli Oct. 1991 22 p
(DE92-619254; IC-91/357) Avail: NTIS HC/MF A03

In the framework of the canonical quantization of general relativity, quantum field theory on a fixed background formally arises in an expansion in powers of the Planck length. In order to renormalize the theory, quadratic terms in the curvature must be included in the gravitational action from the beginning. These terms contain higher derivatives which change the Hamiltonian structure of the theory completely, making the relation between the renormalized-theory and the original one not clear. We show that it is possible to avoid this problem. We replace the higher derivative theory by a second order one. The classical solutions of the latter are also solutions of the former. We quantize the theory, renormalize the infinities, and show that there is a smooth limit between the classical and the renormalized theories. We work in a Robertson Walker minisuperspace with a quantum scalar field. DOE

N92-25337# International Centre for Theoretical Physics, Trieste (Italy).
HIGHER DIMENSIONAL BLACK-HOLES
M. Banados, C. Teitelboim, and J. Zanelli Oct. 1991 18 p
(DE92-616918; IC-91/303) Avail: NTIS HC/MF A03

Spherically symmetric solutions for Lovelock gravity are studied in the hamiltonian formalism. The natural definition of the energy as the numerical value of the hamiltonian is used. It is shown that there exists a particular choice of the Lovelock coefficients which satisfies the following properties: (1) the chaotic time evolution, present in a generic Lovelock theory, is eliminated; (2) there is a curvature (black hole) singularity at $r = 0$ only for even spacetime dimensions, while odd dimensional spacetimes are non singular; (3) for dimensions $D = 4k$ a horizon exists only when the energy is positive (cosmic censorship), while for $D = 4k + 2$ there are both dressed and naked singularities. This particular lagrangian comes from a gauge theory with a SO(D-1,2) or SO(D,1) symmetry. DOE

N92-25545*# California Inst. of Tech., Pasadena. Lab. of Physics.
MEASUREMENT OF THE SIZES OF CIRCUMSTELLAR DUST SHELLS AROUND EVOLVED STARS WITH HIGH MASS LOSS RATES Final Report, 15 Jun. 1989 - 30 Nov. 1991
T. G. Phillips and G. R. Knapp (Princeton Univ., NJ.) 9 Jan. 1992 47 p Submitted for publication
(Grant NAG5-1153)
(NASA-CR-189909; NAS 1.26:189909) Avail: NTIS HC/MF A03

The research supported by the NASA ADP contract NAG5-1153 has been completed. The attached paper, which will be submitted for publication in the Astrophysical Journal in January 1992, presents the results of this work. Here is a summary of the project and its results. A set of computer programs was developed to process the raw 60 micron and 100 micron IRAS survey data. The programs were designed to detect faint extended emission surrounding a bright unresolved source. Candidate objects were chosen from a list of red giant stars and young planetary nebulae which have been detected in millimeter/submillimeter lines of CO. Of the 279 stars examined, 55 were resolved at 60 microns. The principle results of the study are given. The average age for the shells surrounding the 9 Mira-type stars which are extended is 6 x 10(exp 4) yr. This suggests that the period during which these stars lose mass lasts for approx 10(exp 5) yr. The oldest shell found surrounds U Ori, and the youngest surrounds Mira itself. Some shells appear to be detached from the central star. This phenomenon is more common among older stars, suggesting that the mass loss becomes more episodic as the star sheds its envelope. Although all 8 stars less distant than 200 pc are resolved in the IRAS 60 micron data, 29 stars within 500 pc were not. These stars probably have younger circumstellar shells than those which were resolved. Almost all the carbon stars with distances of 500 pc or less have resolved shells, while only 1/2 of the oxygen-rich stars do. The resolved carbon star shells also are older on average than the oxygen-rich ones. These facts imply that carbon stars have been losing mass for a longer period, on average, than oxygen-rich red giants. Large circumstellar shells tend to be found at large distances from the galactic plane, confirming that the ISM density limits the size to which a dust shell can grow. Surprisingly, even very large shells seem to be nearly spherical, and do not appear to be distorted by ram-pressure caused by the star's motion with respect to the ISM. Radiative transfer models and the value of I sub 60 microns/I sub 100 microns allow the average dust temperature in the outer regions of a circumstellar shell to be estimated. The typical value obtained in about 35 K. Author

N92-25562 Arizona Univ., Tucson.
DISK COMPONENTS IN EARLY TYPE GALAXIES Ph.D. Thesis
Hans-Walter Reinhard Rix 1991 220 p
Avail: Univ. Microfilms Order No. DA9208032

This thesis clarifies the role of disk components embedded in the spheroids of early type galaxies, with particular focus on the frequency and structure of disks in galaxies conventionally classified as 'ellipticals'. We discuss both photometric and spectroscopic means of assessing disks. Using simple photometric models, we explore what physical disk parameters result in detectable photometric signatures. We discuss in particular the deviations of the projected isophotes from perfect ellipses in disk/spheroid systems. We show that a wide range of intrinsic disk-to-spheroid ratios (D/S) can produce very similar photometric signatures, depending on viewing angle. We find the distribution of observed isophote distortions in a sample of ellipticals with published surface photometry to be consistent with the D/S hypothesis, implying that about half of the sample members could contain disks with D/S approx. 0.25. To confront our models with a more suitable set of data, we obtained surface photometry at 0.4 microns and 1.6 microns for a statistical sample of about 80 galaxies, comprised of both E's and S0's. Analyzing this data set, we find that in any given luminosity bin of early type galaxies, one third of the objects contain disks whose detectability depends on a favorably high inclination. This fraction was estimated independently from isophote distortions and from radial luminosity profiles. The apparent smooth transition between disk galaxies and purely spheroidal objects can be explained exclusively by changes in the viewing angle, even assuming two discrete classes of early type galaxies (either having substantial disks or none at all). There is no need to invoke continuity along the Hubble sequence from E's to S0's. For the members of this sample, we find a considerable range in D/S, 0.15 less than D/S less than 5. However, most of that variation is caused by changes in the relative scale lengths rather than by changes in disk surface brightness. Dissert. Abstr.

N92-25584 California Inst. of Tech., Pasadena.
THE LARGE-SCALE STRUCTURE OF THE UNIVERSE Ph.D. Thesis
Alain Picard 1991 240 p
Avail: Univ. Microfilms Order No. DA9137278

We present a catalogue of galaxies from COSMOS scans of 16 second epoch Palomar Observatory Sky Survey (POSS-II) plates. The survey covers an area of 386 sq degs, and covers 150,000 galaxies in the magnitude range 16.5 less than or = r less than or = 19.0. The plates are divided into a north galactic and south galactic field. The magnitude scale of each plate was brought to a common photometric system (Gunn r) using extensive CCD photometry. The total error in the zero point of the magnitude scale at the faint end is 0.06 sup m. The procedure for separating stars and galaxies is based on image parameters provided by the COSMOS machine. We have measured the angular correlation function of galaxies w(theta). The north field is in good agreement with the results of the APM survey. The south field exhibits more power on large scales than the north field. The measured correlation function for both fields are incompatible with the predictions of the currently most popular model, cold dark matter (CDM). The number counts of galaxies in the two fields are substantially different. The effect is not the result of a systematic error in zero point of the magnitude system or due to extinction or obscuration. The natural scale for structures which might be responsible for this difference is $50/h Mpc. We have developed an objective algorithm for detecting clusters of galaxies from our galaxy catalogue. The algorithm is based on fixed overdensities at varying angular scales. We present a catalogue of clusters based on this algorithm, using an overdensity threshold obtained from comparing the cluster's densities to each field's overall background density. The objective catalogue is compared with that of Abell's. Poor agreement is found between the two catalogues. Dissert. Abstr.

N92-25641 California Inst. of Tech., Pasadena.
THE I-BAND TULLY-FISHER RELATION AND LARGE-SCALE MOTIONS IN THE UNIVERSE Ph.D. Thesis
Mingsheng Han 1991 326 p
Avail: Univ. Microfilms Order No. DA9209459

The ultimate goal of this thesis is to better understand the large-scale motions in the universe on scales beyond the Local-Supercluster, and also to better understand the Tully-Fisher relation as a distance indicator. Sixteen clusters of galaxies with redshifts that range from 3000-10,000 kms(exp -1) are studied as test points of the large-scale velocity field, using the I-band Tully-Fisher relation as a distance indicator. A complete observational procedure and techniques of measuring cluster distance using the Tully-Fisher relation are investigated in detail, which involves many general topics in the photometric studies of galaxies. Major discussions and results in the thesis are as follows: (1) Charge Coupled Device (CCD) surface photometry is described; (2) internal absorption in spiral galaxies is investigated; (3) techniques for deriving cluster distances using the Tully-Fisher relation are compared; (4) global photometric properties of the cluster galaxies are examined; and (5) a peculiar velocity field, as traced by sample clusters, is found to be highly non-random.
Dissert. Abstr.

N92-25729*# Calvert Inst., Inc., Port Republic, MD.
EXPERIMENTAL STUDIES OF NUCLEATION AND GROWTH PROCESSES RELATED TO THE FORMATION OF PRESOLAR GRAINS Annual Report
Otto E. Berg 15 May 1992 7 p
(Grant NAG5-1494)
(NASA-CR-185481; NAS 1.26:185481) Avail: NTIS HC/MF A02

An understanding was sought for the mechanisms of nucleation of refractory materials, and the relative importance of factors controlling the rate of cluster formation and growth for astrophysically important species. The structure and composition of the condensates is being studied, with the goal of characterizing the grains present in the primitive solar nebula. Author

N92-25735*# Lawrence Livermore National Lab., CA. Physics Dept.
UV LINE DIAGNOSTICS OF ACCRETION DISK WINDS IN CATACLYSMIC VARIABLES Final Report, 1 Sep. 1990 - 29 Feb. 1992
Peter Vitello and Isaac Shlosman (Kentucky Univ., Lexington.) 29 Feb. 1992 66 p
(Contract NAG5-1387; W-7405-eng-48)
(NASA-CR-190219; NAS 1.26:190219) Avail: NTIS HC/MF A04

The IUE data base is used to analyze the UV line shapes of cataclysmic variables RW Sex, RW Tri, and V Sge. Observed lines are compared to synthetic line profiles computed using a model of rotating bi-conical winds from accretion disks. The wind model calculates the wind ionization structure self-consistently including photoionization from the disk and boundary layer and treats 3-D line radiation transfer in the Sobolev approximation. It is found that winds from accretion disks provide a good fit for reasonable parameters to the observed UV lines which include the P Cygni profiles for low inclination systems and pure emission at large inclination. Disk winds are preferable to spherical winds which originate on the white dwarf because they (1) require a much lower ratio of mass loss rate to accretion rate and are therefore more plausible energetically, (2) provide a natural source for a bi-conical distribution of mass outflow which produces strong scattering far above the disk leading to P Cygni profiles for low inclination systems, and pure line emission profiles at high inclination with the absence of eclipses in UV lines, and (3) produce rotation broadened pure emission lines at high inclination.
Author

N92-25322*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE COSMIC AND HELIOSPHERIC PANEL
Richard A. Mewaldt, Glenn M. Mason, Aaron Barnes, W. Robert Binns, Leonard F. Burlaga, Michael L. Cherry, Thomas E. Holzer,

J. R. Jokipii (Arizona Univ., Tucson.), Vernon Jones, and James C. Ling et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 15-37 Prepared in cooperation with JPL; California Inst. of Tech., Pasadena; Chicago Univ., IL; and Michigan Univ. Original contains color illustrations (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

N92-25323*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE IONOSPHERE-THERMOSPHERE-MESOSPHERE PANEL
Edward P. Szuszczewicz, Tim L. Killeen, Roger L. Arnoldy, Larry H. Brace, Andrew B. Christensen, B. Fejer, Roderick A. Heelis, Michael J. Keskinen, Nelson C. Maynard, and Hans G. Mayr (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 39-48 Prepared in cooperation with Johns Hopkins Univ., Laurel, MD; and National Center for Atmospheric Research, Boulder, CO. Original contains color illustrations (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

N92-25324*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE MAGNETOSPHERIC PHYSICS PANEL
James L. Burch, Thomas A. Potemra, Maha AshourAbdalla, Daniel N. Baker, Cynthia A. Cattell, Andrew F. Chang, Louis A. Frank, Christoph K. Goertz, Margaret G. Kivelson, and Lou-Chuang Lee (Alaska Univ., Fairbanks.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 49-66 Prepared in cooperation with Rice Univ., Houston, TX; and Lockheed Missiles and Space Co., Palo Alto, CA Original contains color illustrations (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

N92-25678# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Inst. d'Astrophysique Spatiale.
IN-SITU DOPPLER VELOCIMETRY OF VERY LARGE GRAINS: AN ESSENTIAL GOAL FOR FUTURE COMETARY INVESTIGATIONS
J. F. Crifo *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 65-70 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25783# Oulu Univ. (Finland). Dept. of Astronomy.
SIMULATIONS OF SELF-GRAVITATING SYSTEMS
Heikki Salo (Helsinki Univ. of Technology, Espoo, Finland), Jyrki Lukkari, and Jyrki Haenninen *In its* Second Meeting of Finnish Space Researchers 1990 p 55-57 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-25173*# Stanford Univ., CA.
AN INVESTIGATION OF MECHANISMS OTHER THAN LIGHTNING TO EXPLAIN CERTAIN WIDEBAND PLASMA WAVE BURSTS DETECTED IN THE VENUSIAN NIGHTSIDE IONOSPHERE Final Report, 1 Apr. 1988 - 29 Feb. 1992
D. L. Carpenter 1992 24 p
(Grant NAG2-520)
(NASA-CR-190127; NAS 1.26:190127) Avail: NTIS HC/MF A03

Several related topics are briefly discussed. Reviewed here is work on an investigation of plasma wave phenomena associated with the question of lightning on Venus. The work supported the contention that lightning is at least a candidate explanation for many of the 100 Hz-only Pioneer Venus orbital electric field detector (OEFD) signals. A review of the work on the investigation of mechanisms other than lightning to explain certain wideband plasma wave bursts detected in the Venusian nightside ionosphere is given. A summary is given of our analysis of data from 23 OEFD observing periods as well as a discussion of the properties of specifically multifrequency events. Our opportunity to work on this topic was not sufficient to draw any firm conclusions about the origins of the multifrequency bursts, but we call attention to what we consider to be several candidate sources. Also discussed are case studies to test for evidence of whistler mode propagation from subionospheric sources, results of a search for dispersive effects in the OEFD data, the results for a search for simultaneous 100 Hz and 730 Hz observations at altitudes below 150 km, changes with altitude in dispersive broadening effects in the time signatures of 100 Hz bursts, and a survey of activity at altitudes above 1000 km. Author

N92-25258*# RAND Corp., Santa Monica, CA.
AUTOMATION AND ROBOTICS FOR THE SPACE EXPLORATION INITIATIVE: RESULTS FROM PROJECT OUTREACH
D. Gonzales, D. Criswell, and E. Heer 1991 89 p
(Contract F49620-86-C-0003)
(NASA-TM-107823; NAS 1.15:107823; RAND/N-3284-AF/NASA)
Avail: NTIS HC/MF A05

A total of 52 submissions were received in the Automation and Robotics (A&R) area during Project Outreach. About half of the submissions (24) contained concepts that were judged to have high utility for the Space Exploration Initiative (SEI) and were analyzed further by the robotics panel. These 24 submissions are analyzed here. Three types of robots were proposed in the high scoring submissions: structured task robots (STRs), teleoperated robots (TORs), and surface exploration robots. Several advanced TOR control interface technologies were proposed in the submissions. Many A&R concepts or potential standards were presented or alluded to by the submitters, but few specific technologies or systems were suggested. Author

N92-25280*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
STUDY AND INTERPRETATION OF THE MILLIMETER-WAVE SPECTRUM OF VENUS Technical Report No. 1992-1
Antoine K. Fahd and Paul G. Steffes Jun. 1992 175 p
(Grant NAGw-533)
(NASA-CR-190339; NAS 1.26:190339) Avail: NTIS HC/MF A08

The effects of the Venus atmospheric constituents on its millimeter wavelength emission are investigated. Specifically, this research describes the methodology and the results of laboratory measurements which are used to calculate the opacity of some of the major absorbers in the Venus atmosphere. The pressure broadened absorption of gaseous SO2/CO2 and gaseous H2SO4/CO2 has been measured at millimeter wavelengths. We have also developed new formalisms for computing the

absorptivities of these gases based on our laboratory work. The complex dielectric constant of liquid sulfuric acid has been measured and the expected opacity from the liquid sulfuric acid cloud layer found in the atmosphere of Venus has been evaluated. The partial pressure of gaseous H2SO4 has been measured which results in a more accurate estimate of the dissociation factor of H2SO4. A radiative transfer model has been developed in order to understand how each atmospheric constituent affects the millimeter wave emissions from Venus. Our results from the radiative transfer model are compared with recent observations of the micro-wave and millimeter wave emissions from Venus. Our main conclusion from this work is that gaseous H2SO4 is the most likely cause of the variation in the observed emission from Venus at 112 GHz. Author

N92-25414*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONSTRUCTING AN ADVANCED SOFTWARE TOOL FOR PLANETARY ATMOSPHERIC MODELING
Richard M. Keller, Michael Sims, Ester Podolak (Complex Systems Research, Inc., Boulder, CO.), and Christopher McKay Aug. 1990 6 p Previously announced in IAA as A92-23692
(NASA-TM-107890; NASA-FIA-90-8-29-01; NAS 1.15:107890)
Avail: NTIS HC/MF A02

Scientific model building can be an intensive and painstaking process, often involving the development of large and complex computer programs. Despite the effort involved, scientific models cannot be easily distributed and shared with other scientists. In general, implemented scientific models are complex, idiosyncratic, and difficult for anyone but the original scientist/programmer to understand. We believe that advanced software techniques can facilitate both the model building and model sharing process. In this paper, we describe a prototype for a scientific modeling software tool that serves as an aid to the scientist in developing and using models. This tool includes an interactive intelligent graphical interface, a high level domain specific modeling language, a library of physics equations and experimental datasets, and a suite of data display facilities. Our prototype has been developed in the domain of planetary atmospheric modeling, and is being used to construct models of Titan's atmosphere. Author

N92-25459*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PROPOSAL FOR CONSTRUCTING AN ADVANCED SOFTWARE TOOL FOR PLANETARY ATMOSPHERIC MODELING
Richard M. Keller, Michael H. Sims, Esther Podolak, Christopher P. McKay, and David E. Thompson Mar. 1990 20 p
(NASA-TM-107894; NASA-RIA-90-03-20-1; NAS 1.15:107894)
Avail: NTIS HC/MF A03

Scientific model building can be a time intensive and painstaking process, often involving the development of large and complex computer programs. Despite the effort involved, scientific models cannot easily be distributed and shared with other scientists. In general, implemented scientific models are complex, idiosyncratic, and difficult for anyone but the original scientist/programmer to understand. We believe that advanced software techniques can facilitate both the model building and model sharing process. We propose to construct a scientific modeling software tool that serves as an aid to the scientist in developing and using models. The proposed tool will include an interactive intelligent graphical interface and a high level, domain specific, modeling language. As a testbed for this research, we propose development of a software prototype in the domain of planetary atmospheric modeling. Author

N92-25561 Arizona Univ., Tucson.
OBSERVATIONS AND MODELLING OF THE MARTIAN WATER VAPOR BUDGET FOR 1988-1989 Ph.D. Thesis
Bashar Rizk 1991 424 p
Avail: Univ. Microfilms Order No. DA9208033

During 1988-89, the 1.5 m telescope on Mt. Bigelow, Arizona, combined with the Lunar and Planetary Laboratory echelle spectrograph, recorded 20 spectral CCD images of Mars during early spring, mid- and late summer, and autumnal equinox in its Southern Hemisphere. These images contained absorption features which permitted latitudinally resolved measurements of water vapor column abundance in the Martian atmosphere on these four occasions, corresponding to the areocentric longitudes (L sub theta) 208, 320, 340, and 360 degrees. The acquisition, analysis, and modeling of this data set are described. Photochemical models at different latitudes predicted ozone column abundance at L(sub theta) = 208 degrees when initialized by the observed water vapor abundances. Matching simultaneous ozone abundances, also measured from the ground, required eddy diffusivities at altitudes between 5 and 15 km that were at least two orders of magnitude lower than the values greater than 10 (exp 8) cm(exp 2) sec(exp -1) assumed above 30 km altitude, especially at south polar latitudes. Legendre polynomials and interpolating parabolas described the observed spatial and temporal behavior of the Martian water vapor for L (sub theta) 20, 340, and 360 degrees. Integrating the fits with latitude derived visible disk and globally averaged abundances as a function of time. A budget based on these abundances suggested the Southern Hemisphere subsurface to be a source, and therefore a reservoir, of water vapor during this season. The large magnitudes and signs of effective meridional diffusivities for the data implied the water vapor's disappearance to be more likely due to condensation and adsorption into local sinks than to atmospheric transport. When compared with Viking water vapor data, the Catalina abundances hinted that dust was a mechanism for shielding water vapor from ground-based observation and that northward transport was more efficient during a dusty southern spring and summer than during a dustless one. Dissert. Abstr.

N92-25585 Arizona Univ., Tucson.
RECOVERING THE HYDROCARBON DISTRIBUTIONS IN SATURN'S UPPER ATMOSPHERE THROUGH MATHEMATICAL INVERSION Ph.D. Thesis
Da Sheng Feng 1991 146 p
Avail: Univ. Microfilms Order No. DA9210273

The spacecraft Voyager 2 UVS occultation experiments measured the ultraviolet absorption properties of the upper atmosphere of Saturn. In the extreme-ultraviolet wavelength region from 1300 to 1700 A, CH4, C2H2, C2H4, C2H6 and C4H2 are the major absorbers in the Saturnian upper atmosphere. Using the linear constrained matrix method, the Saturnian stellar EUV occultation data has been inverted. This results in, for the first time, the number density distributions of the 5 major hydrocarbons over an altitude range from 1030 to 630 km. The synthetic transmission curves based on these inverted distributions exhibit excellent agreement with the observed transmission curves in all usable wavelength channels. There are two major findings in the Saturnian upper atmosphere from the inverted hydrocarbon profiles: (1) The number densities of CH4 and C2H6 are comparable. It is even likely that there is more C2H6 than CH4 in Saturn's upper atmosphere between 1000 km and 800 km. (2) C2H4, rather than C2H2, is the 3rd most abundant hydrocarbon. From 1000 km down to 600 km, the number density of C2H4 is greater than the number density of C2H2. Dissert. Abstr.

N92-25639 Arizona Univ., Tucson.
ENERGY ANALYSIS OF MANUFACTURING PROCESSES ON THE MOON Ph.D. Thesis
Belinda Gum-Hung Wong-Swanson 1991 125 p
Avail: Univ. Microfilms Order No. DA9210280

A methodology for the energy analysis of high temperature lunar manufacturing processes is presented. The Moon's environment creates unique thermodynamic and heat rejection problems due to the absence of an atmosphere and large ambient temperature swing as it goes from lunar day to lunar night; it is a perfect vacuum at the surface. The methodology combines availability analysis, the Pinch technology, and a mathematical heat rejection model to minimize energy requirements and the lift-off mass from earth. The availability analysis is used to identify process irreversibilities and to determine the quality of energy from various

exit streams. The Pinch technology is used to identify hot and cold streams for potential process heat integration. The heat rejection model is used to optimize the radiator area with temperature as the driving factor. The methodology presented allows one to identify all power consumption, production and rejection in the process, and then determine the feasibility of heat and work integration without a significant mass penalty. It provides a means to design a power system to minimize waste energy. This would result in reduction of the power requirement, cost of power and the power system's mass. Dissert. Abstr.

N92-25671*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VLA/GOLDSTONE (CALIFORNIA) PLANETARY RADAR RESULTS
A. W. Grossman, D. O. Muhleman, M. A. Slade, and B. J. Butler (California Inst. of Tech., Pasadena.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 19-22 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
(Grant NSF AST-91-00306)
Copyright Avail: NTIS HC/MF A07

N92-25672*# Stanford Univ., Palo Alto, CA. Center for Radar Astronomy.
BISTATIC RADAR STUDIES OF THE PLANETS
Ivan R. Linscott, G. Leonard Tyler, Essam A. Marouf, and Richard A. Simpson *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 23-29 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25673*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MAGELLAN MISSION DESCRIPTION AND RADAR SYSTEM
William T. K. Johnson *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 33-38 Sponsored by NASA, Washington (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25674# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
RESULTS FROM THE MAGELLAN ALTIMETER
Peter G. Ford, Gordon H. Pettengill, and Fang Liu *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 39-44 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25675# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
VENUS: SURFACE DIELECTRIC PROPERTIES
Gordon H. Pettengill and Peter G. Ford *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 45-48 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25676# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
MARS 96 SUBSURFACE RADAR
Y. Barbin, W. Kofman, M. Elkine, M. Finkelstein, V. Glotov, and V. Zolotarev (Academy of Sciences of the Latvian SSR, Riga.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 51-58 Sponsored by CNES and Academy of Sciences Space Research Inst. (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25677# Centre National d'Etudes Spatiales, Toulouse (France). Radar Dept.
DEFINITION OF A L-BAND SAR FOR A MARS ROVER MISSION
A. Lifermann and E. Thouvenot *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 59-63 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25679# Nice Univ. (France).
ASTRA: ALTIMETRY AND SOUNDING OF TITAN WITH A RADAR ON A DESCENDING CRAFT
P. Kamoun, J. C. Anne, and Peter G. Ford (Massachusetts Inst. of Tech., Cambridge.) *In* ESA, Radars and Lidars in Earth and Planetary Sciences Dec. 1991 p 71-78 (For primary document see N92-25668 16-32)
Copyright Avail: NTIS HC/MF A07

N92-25764# Oulu Univ. (Finland). Taehtitieteen Laitos.
ALBA PATERA: EVOLUTIONARY PHASES OF A MARTIAN VOLCANO [ALBA PATERA: TULIVUOREN KEHITYSVAIHEITA MARSISSA]
Kauko Kauhanen *In its* Second Meeting of Finnish Space Researchers 1990 p 11-12 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25773# Helsinki Univ. of Technology, Espoo (Finland). Observatory.
TV IMAGING OF PHOBOS, VSK (VIDEOSPECTROMETRIC COMPLEX) EXPERIMENT
Kari Lumme *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 31-32 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25774# Helsinki Univ. of Technology, Espoo (Finland). Observatory and Astrophysics Lab.
STATISTICAL TOPOGRAPHY OF PHOBOS Abstract Only
Karri Muinonen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 33 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25777# Helsinki Univ. of Technology, Espoo (Finland). Ilmatieteen Laitos.
INSTITUTE OF METEOROLOGY SPACE STUDIES PROGRAM [ILMATIETEEN LAITOKSEN AVARUUSTUTKIMUSOHJELMA]
Risto Pellinen *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 39-41 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25778# Oulu Univ. (Finland). Taehtitieteen Laitos.
PLANETARY GEOLOGY: TECTONICS OF TERRESTRIAL PLANETS AND OF THE MOON [PLANEETTAGEOLOGIA: TERRESTRISTEN PLANEETTOJEN JA KUUN TEKTONIIKKA]
Jouko Raitala *In its* Second Meeting of Finnish Space Researchers 1990 p 43-44 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25790# Oulu Univ. (Finland). Taehtitieteen Laitos.
AN EVENTUAL HOT SPOT MARK ON VENUS [MAHDOLLINEN HOT SPOT: JAELKI VENUKSELLA]
Terhi Toermaenen and Jouko Raitala *In its* Second Meeting of Finnish Space Researchers 1990 p 71-72 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N92-25431*# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
THE FLOW OF PLASMA IN THE SOLAR TERRESTRIAL ENVIRONMENT Final Technical Report, 1 Jul. 1980 - 30 Sep. 1990
Robert W. Schunk, P. Banks, A. R. Barakat, D. J. Crain, H. G. Demars, J. Lemaire, T.-Z. Ma, C. E. Rasmussen, P. Richards, and R. Sica et al 30 Sep. 1990 50 p
(Grant NAGw-77)
(NASA-CR-190082; NAS 1.26:190082) Avail: NTIS HC/MF A03

The overall goal of our NASA Theory Program was to study the coupling, time delays, and feedback mechanisms between the various regions of the solar-terrestrial system in a self-consistent, quantitative manner. To accomplish this goal, it will eventually be necessary to have time-dependent macroscopic models of the different regions of the solar-terrestrial system and we are continually working toward this goal. However, with the funding from this NASA program, we concentrated on the near-earth plasma environment, including the ionosphere, the plasmasphere, and the polar wind. In this area, we developed unique global models that allowed us to study the coupling between the different regions. These results are highlighted in the next section. Another important aspect of our NASA Theory Program concerned the effect that localized 'structure' had on the macroscopic flow in the ionosphere, plasmasphere, thermosphere, and polar wind. The localized structure can be created by structured magnetospheric inputs (i.e., structured plasma convection, particle precipitation or Birkland current patterns) or time variations in these input due to storms and substorms. Also, some of the plasma flows that we predicted with our macroscopic models could be unstable, and another one of our goals was to examine the stability of our predicted flows. Because time-dependent, three-dimensional numerical models of the solar-terrestrial environment generally require extensive computer resources, they are usually based on relatively simple mathematical formulations (i.e., simple MHD or hydrodynamic formulations). Therefore, another goal of our NASA Theory Program was to study the conditions under which various mathematical formulations can be applied to specific solar-terrestrial regions. This could involve a detailed comparison of kinetic, semi-kinetic, and hydrodynamic predictions for a given polar wind scenario or it could involve the comparison of a small-scale particle-in-cell (PIC) simulation of a plasma expansion event with a similar macroscopic expansion event. The different mathematical formulations have different strengths and weaknesses and a careful comparison of model predictions for similar geophysical situations provides insight into when the various models can be used with confidence. Author

N92-25434# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 567, NOVEMBER 1991. PART 1: (PROMPT REPORTS). DATA FOR OCTOBER, SEPTEMBER 1991 AND LATE DATA
H. E. Coffey Nov. 1991 160 p
(PB92-137165; SGD-567-Pt-1) Avail: NTIS HC/MF A08

A detailed index for 1991 is given. Data is given for October 1991 on the solar-terrestrial environment, IUWDS alert periods, solar activity indices, solar flares, solar radio emission, and the Stanford mean solar magnetic field. Data for September 1991 is given on solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices. The 1991 International Geophysical Calendar with recommended scientific programs is given. Author

N92-25436# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 568, DECEMBER 1991. PART 2: (COMPREHENSIVE REPORTS). DATA FOR JUNE 1991 AND MISCELLANEOUS
H. E. Coffey Jun. 1991 133 p
(PB92-140649; SGD-568-Pt-2) Avail: NTIS HC/MF A07

A detailed index is given for 1991. Data is given for June 1991 for solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from the GOES satellite, mass ejections from the sun, and active prominences and filaments. Miscellaneous data is given on GOES solar proton events from October 1976 to October 1991. Author

N92-25437# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 568, DECEMBER 1991. PART 1: (PROMPT REPORTS). DATA FOR NOVEMBER, OCTOBER 1991 AND LATE DATA
H. E. Coffey Dec. 1991 165 p
(PB92-140656; SGD-568-Pt-1) Avail: NTIS HC/MF A08

A detailed index is given for 1991. Data is given for November 1991 on the solar-terrestrial environment, IUWDS alert periods, solar activity indices, solar flares, solar radio emission, and the Stanford mean solar magnetic field. Data for October 1991 is given for solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices. Late data is given on cosmic ray measurements by neutron monitor and geomagnetic indices. Author

N92-25460# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 566, OCTOBER 1991. PART 1: (PROMPT REPORTS). DATA FOR SEPTEMBER, AUGUST 1991 AND LATE DATA
H. E. Coffey Oct. 1991 180 p
(PB92-129394; SGD-566-Pt-1) Avail: NTIS HC/MF A09

A detailed index for 1991 is given. Data for September 1991 is given for the solar-terrestrial environment, IUWDS alert periods, solar activity indices, solar flares, solar radio emission, and Stanford mean solar magnetic field. Data is given for August 1991 for solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices. Late data is given on cosmic ray measurements by neutron monitor for November 1990 to June 1991, and geomagnetic activity indices for June and July 1991. Author

N92-25463# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 567, NOVEMBER 1991. PART 2: (COMPREHENSIVE REPORTS). DATA FOR MAY 1991 AND MISCELLANEOUS
H. E. Coffey Nov. 1991 117 p
(PB92-137173; SGD-567-Pt-2) Avail: NTIS HC/MF A06

A detailed index is given for 1991. Data is given for May 1991 on solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from the GOES satellite, mass ejections from the sun, and active prominences and filaments. Miscellaneous data includes the 1992 International Geophysical Calendar with recommended scientific programs. Author

N92-25475# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 564, AUGUST 1991. PART 1: (PROMPT REPORTS). DATA FOR JULY, JUNE 1991, AND LATA DATA
H. E. Coffey Aug. 1991 171 p
(PB92-111681; SGD-564-Pt-1) Avail: NTIS HC/MF A08

A detailed index for 1990-1991 is given. Data are given for the July 1991 solar terrestrial environment, IUWDS alert periods, solar activity indices, solar flares, Stanford mean solar magnetic field, solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices. Author

N92-25549# Helsinki Univ. of Technology, Kylmaelae (Finland). Metsaehovi Radio Research Station.
SOLAR MICROWAVE RADIATION MAPS MEASURED AT METSAEHOVI RADIO RESEARCH STATION IN 1989

S. Urpo, S. Pohjolainen, H. Teraesranta, and K. Karlamaa 1991 53 p
(PB92-138049; ISBN-951-22-0562-9; SER-A-6) Avail: NTIS HC/MF A04

The Metsaehovi Radio Research Station operates a 14 m diameter radio telescope. Annually the telescope is reserved for solar measurements for 4-10 weeks, typically during summer months. Measurements include maps of the whole or part of the Sun, tracking of active regions, and solar oscillation monitoring. Most of the solar maps have been measured using receivers operating at 36.8 GHz. The purpose of the report series is to publish at least one map for each of the days when measurements were performed. For some of these days there exist several measured maps. The volume contains selected maps measured in 1989. A list of all measured maps during this period is included. GRA

N92-25582 California Univ., Santa Barbara.
THE TOPOGRAPHIC VARIABILITY OF SOLAR RADIATION Ph.D. Thesis
Ralph O. Dubayah 1991 188 p
Avail: Univ. Microfilms Order No. DA9204596

This research explores the spatial and temporal variability of incoming and net solar radiation over different topographic regions and examines the atmospheric and terrain parameters that control this variability. A twostream radiative transfer algorithm is used with digital elevation data and atmospheric optical properties to model the detailed interaction of incoming direct and diffuse solar irradiance with a reflective topographic surface. The mean, variance, and spatial autocorrelation in incoming solar radiation are compared for different regions, including the Konza Prairie, home of the First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE). A simplified radiation model is used to identify the physical factors controlling differences in radiation regimes among terrain. Topography does not significantly affect the regional mean calculated over 10 x 10 sq km areas, except for the most rugged terrain. Average spatial autocorrelation in incoming radiation varies from 200 to 1200 m depending on the terrain. The radiation model is also used with LANDSAT Thematic Mapper data and digital elevation data to estimate net solar radiation across the FIFE site. Model estimates are in excellent agreement with field pyranometer measurements. Topography is the most important factor controlling the spatial variability of net solar radiation for the site. Variability in reflectance is of secondary importance. If the effects of topography on satellite reflectance and incoming irradiance are ignored, the resulting map of apparent net solar radiation shows little spatial variability and poor correlation with field measurements. Dissert. Abstr.

N92-25956*# Boeing Co., Seattle, WA. Defense and Space Group.
ATOMIC OXYGEN EXPOSURE OF LDEF EXPERIMENT TRAYS
R. J. Bourassa and J. R. Gillis May 1992 363 p
(Contracts NAS1-18224; NAS1-19247)
(NASA-CR-189627; NAS 1.26:189627) Avail: NTIS HC/MF A16

Atomic oxygen exposures were determined analytically for rows, longerons, and end bays of the Long Duration Exposure Facility (LDEF). The calculations are based on an analytical model that accounts for the effects of thermal molecular velocity, atmospheric temperature, number density, spacecraft velocity, incidence angle, and atmospheric rotation on atomic oxygen flux. Results incorporate variations in solar activity, geomagnetic index, and orbital parameters occurring over the 6-year flight of the spacecraft. To facilitate use of the data, both detailed tabulations and summary charts for atomic oxygen fluences are presented. Author

N92-25973# Arizona Univ., Tucson. Dept. of Physics.
SOLAR VARIABILITY OBSERVED THROUGH CHANGES IN SOLAR LIMB-DARKENING FUNCTION AND MEAN DIAMETER
H. A. Hill 1991 20 p
(Contract DE-FG02-87ER-13670)
(DE92-008791; DOE/ER-13670/5) Avail: NTIS HC/MF A03

Long-term changes in the apparent solar diameter/limb-darkening functions are investigated. Additionally, work on solar gravity modes and development of inverse techniques are presented. DOE

N92-26013*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 1989 SOLAR MAXIMUM MISSION EVENT LIST
B. R. Dennis, J. P. Licata, and A. K. Tolbert (ST Systems Corp., Lanham, MD.) Mar. 1992 611 p
(NASA-TM-4344; NAS 1.15:4344; Rept-92B00040) Avail: NTIS HC/MF A99

This document contains information on solar burst and transient activity observed by the Solar Maximum Mission (SMM) during 1989 pointed observations. Data from the following SMM experiments are included: (1) Gamma Ray Spectrometer, (2) Hard X-Ray Burst Spectrometer, (3) Flat Crystal Spectrometer, (4) Bent Crystal Spectrometer, (5) Ultraviolet Spectrometer Polarimeter, and (6) Coronagraph/Polarimeter. Correlative optical, radio, and Geostationary Operational Satellite (GOES) X-ray data are also presented. Where possible, bursts or transients observed in the various wavelengths were grouped into discrete flare events identified by unique event numbers. Each event carries a qualifier denoting the quality or completeness of the observations. Spacecraft pointing coordinates and flare site angular displacement values from sun center are also included. Author

N92-26029*# Harvard Coll. Observatory, Cambridge, MA.
LABORATORY STUDIES IN ULTRAVIOLET SOLAR PHYSICS Status Report, period ending 30 Sep. 1991
W. H. Parkinson, J. L. Kohl, L. D. Gardner, J. C. Raymond, and P. L. Smith 1 Oct. 1991 16 p
(Grant NAGw-1687)
(NASA-CR-190240; NAS 1.26:190240) Avail: NTIS HC/MF A03

The research activity comprised the measurement of basic atomic processes and parameters which relate directly to the interpretation of solar ultraviolet observations and to the development of comprehensive models of the component structures of the solar atmosphere. The research was specifically directed towards providing the relevant atomic data needed to perform and to improve solar diagnostic techniques which probe active and quiet portions of the solar chromosphere, the transition zone, the inner corona, and the solar wind acceleration regions of the extended corona. The accuracy with which the physical conditions in these structures can be determined depends directly on the accuracy and completeness of the atomic and molecular data. These laboratory data are used to support the analysis programs of past and current solar observations (e.g., the Orbiting solar Observatories, the Solar Maximum Mission, the Skylab Apollo Telescope Mount, and the Naval Research Laboratory's rocket-borne High Resolution Telescope and Spectrograph). In addition, we attempted to anticipate the needs of future space-borne solar studies such as from the joint ESA/NASA Solar and Heliospheric Observatory (SOHO) spacecraft. Our laboratory activities stressed two categories of study: (1) the measurement of absolute rate coefficients for dielectronic recombination and electron impact excitation; and (2) the measurement of atomic transition probabilities for solar density diagnostics. A brief summary of the research activity is provided. Author

N92-26166# Helsinki Univ. of Technology, Kylmaelae (Finland). Metsaehovi Radio Research Station.
SOLAR MICROWAVE RADIATION MAPS MEASURED AT METSAEHOVI RADIO RESEARCH STATION IN 1987-1988
S. Urpo, S. Pohjolainen, H. Teraesranta, and K. Kariamaa 1991 75 p
(PB92-136787; ISBN-951-22-0561-0; SER-A-5) Avail: NTIS HC/MF A04

The Metsaehovi Radio Research Station operates a 14 m diameter radio telescope. Annually the telescope is reserved for solar measurements for 4-10 weeks, typically during summer months. Measurements include maps of the whole or part of the Sun, tracking of active regions, and solar oscillation monitoring. Most of the solar maps were measured using receivers operating

at 36.8 HGz. The purpose of the report series is to publish at least one map for each of the days when measurements were performed. For some of these days there exist several measured maps. The volume contains selected maps measured in 1987 and 1988. A list of all measured maps during this period is included.
GRA

N92-25325*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE SOLAR PHYSICS PANEL
George L. Withbroe, Richard R. Fisher, Spiro Antiochos, Guenter Brueckner, J. Todd Hoeksema, Hugh Hudson, Ronald Moore, Richard R. Radick, Gary Rottman, and Philip Scherrer (Stanford Univ., CA.) et al *In its* Space Physics Strategy-Implementation Study. Volume 1: Goals, Objectives, Strategy. A Report to the Space Physics Subcommittee of the Space Science and Applications Advisory Committee Apr. 1991 p 67-83 Prepared in cooperation with NASA. Goddard Space Flight Center, Greenbelt, MD; Lockheed Missiles and Space Co., Palo Alto, CA; and California Inst. of Tech., Pasadena, Big Bear Solar Observatory (For primary document see N92-25321 16-88)
Avail: NTIS HC/MF A08; 18 functional color pages

N92-25763# Oulu Univ. (Finland). Dept. of Physics.
SOLAR CYCLE EFFECTS ON MAGNETOSPHERIC ION-CYCLOTRON WAVE ACTIVITY Abstract Only
Jorma Kangas, Kalevi Mursula, Tapani Pikkarainen, and Tapani Rinne *In its* Second Meeting of Finnish Space Researchers 1990 p 9 (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

N92-25789# Turku Univ. (Finland). Avaruustutkimus Lab.
SOLAR PRODUCTION OF NEUTRONS [AURINGON NEUTRONITUOTTO]
Jarmo Torsti *In* Oulu Univ., Second Meeting of Finnish Space Researchers 1990 p 69 In FINNISH (For primary document see N92-25758 16-88)
Avail: NTIS HC/MF A05

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N92-25154# Westinghouse Savannah River Co., Aiken, SC.
GAMMA RAY SPECTROMETRY OF LDEF SAMPLES AT SRL
W. G. Winn 22 Jul. 1991 15 p Presented at the 1st Long Duration Exposure Facility (LDEF) Post-Retrieval Symposium, Kissimmee, FL, 3-8 Jun. 1991
(Contract DE-AC09-89SR-18035)
(DE92-008850; WSRC-MS-91-171; CONF-9106256-3) Avail: NTIS HC/MF A03

A total of 31 samples from the Long Duration Exposure Facility (LDEF), including materials of aluminum, vanadium, and steel trunnions were analyzed by ultra-low-level gamma spectroscopy. The study quantified particle induced activations of Na-22, Sc-46, Cr-51, Mn-54, Co-56, Co-57, Co-58, and Co-60. The samples of trunnion sections exhibited increasing activity toward the outer end of the trunnion and decreasing activity toward its radial center. The trunnion sections did not include end pieces, which have been reported to collect noticeable Be-7 on their leading surfaces. No significant Be-7 was detected in the samples analyzed. The Underground Counting Facility at Savannah River Laboratory (SRL) was used in this work. The facility is 50 ft. underground, constructed with low-background shielding materials, and operated as a clean room. The most sensitive analyses were performed with a 90 percent efficient HPGe gamma-ray detector, which is enclosed in a purged active/passive shield. Each sample was counted for one to six days in two orientations to yield more representative average activities for the sample. The non-standard geometries of the LDEF samples prompted the development of a novel calibration method, whereby the efficiency about the samples surfaces (measured with point sources) predicted the efficiency for the bulk sample.
DOE

N92-25504*# Haverford Coll., PA.
A SEARCH FOR THE DIPOLE ANISOTROPY OF THE COSMIC X RAY BACKGROUND Thesis
Tom Evans 1 May 1992 24 p
(Grant NAG5-1713)
(NASA-CR-190289; NAS 1.26:190289) Avail: NTIS HC/MF A03

X ray data was analyzed which was obtained by the HEAO-1 A2 satellite in order to look for large scale structure in the Cosmic X ray Background. The dipole moment of the x ray background is deltal/I = (1.87 + or - .34)x 10(exp -2) in a direction, declination = 3.6 + or - 9.4 deg and right ascension = 15.9 + or - .2 hr. This implies a velocity of the Earth with respect to the background of 409.2 + or - 74.4 km/s in the same direction. Comparatively, measurements of the dipole anisotropy of the Cosmic Microwave Background imply a velocity of 369.2 + or - 4 km/s in a direction, declination = 6 + or - 1 deg and right ascension = 11.2 + or - .1 hr. Quoted errors are statistical only. The disparity between the velocities of the x ray dipole and microwave dipole may be due to residual structure in the x ray sky or as yet undiscovered systematic errors.
Author

N92-25558 Wisconsin Univ., Madison.
A SEARCH FOR VERY HIGH-ENERGY GAMMA RAYS FROM THE CRAB Ph.D. Thesis
Mark Andrew Skinner 1991 82 p
Avail: Univ. Microfilms Order No. DA9134346

At the Haleakala Gamma Ray Observatory (HGO), the Crab (M1, PSR0531 +21) was observed for a total of 183 hours between August 1989 and January 1991. HGO uses the Atmospheric Cerenkov Technique (ACT) to search for very high energy (VHE) gamma ray sources. The data was searched for long term continuous emission and sporadic emission (time scales of approx. 15 minutes). The data was searched both for steady state emission and emission pulsed at the Crab frequency (as provided by the Nuffield Radio Observatory). No evidence was found for any gamma ray flux. Previous HGO results were reviewed. Given the reported Whipple flux from the Crab (Vacanti et al., 1991), it was estimated, via a detailed Monte Carlo calculation, that gamma ray should have been detected from the Crab at the 9 sigma cl., above ca. 200 GeV.
Dissert. Abstr.

N92-25563 Arizona Univ., Tucson.
LINE EMISSION FROM GALAXIES AT HIGH REDSHIFT Ph.D. Thesis
James Daniel Lowenthal 1991 129 p
Avail: Univ. Microfilms Order No. DA9208021

The results of a multi-faceted search for spectral line emission from galaxies at high redshift are presented. Deep two-dimensional spectra of four blank sky fields were taken at the Multiple Mirror Telescope (MMT) at wavelengths corresponding to redshifted Ly alpha emission in the range 2.7 less than z less than 4.7, and the resulting non-detections are used to place upper limits on the space density of randomly distributed Ly alpha emitters. Although the predictions of a conservative model of galaxy formation incorporating cold dark matter are not excluded in a statistical sense, the search would have detected star-forming dwarf galaxies comparable to the Magellanic Clouds at z = 3, given minimal extinction by dust. The Goddard Fabry-Perot Imager, a piezo-electrically controlled tunable narrow-band filter system with a stand-alone CCD system, was developed and tested, and used at the Kitt Peak National Observatory (KPNO) 4 m telescope to image the damped Ly alpha absorbing clouds towards three high-redshift QSOs in the light of redshifted Ly alpha. A companion galaxy to one of the damped systems was discovered and confirmed with followup spectroscopy, and its properties are presented and discussed; the companion exhibits strong Ly alpha and weak C IV lambda 1549 and He II lambda 1640 emission

lines, and is apparently producing stars at a rate SFR approx. 5 - 10 solar mass yr (exp -1). The implications of the companion's proximity to the damped cloud are analyzed in view of the previous non-detections, and a lower limit to the spatial correlation function of the damped Ly alpha systems with galaxies is given. Spectroscopic limits on Ly alpha emission from seven damped systems, including some known to have low chemical and dust abundances, imply low levels of star formation, SFR approx. less than 1 solar mass yr (exp -1), but extinction by dust in some cases may cause an underestimation of these rates.
Dissert. Abstr.

99 GENERAL

N92-25250*# Edgerton, Germeshausen and Grier, Inc., Cocoa Beach, FL.
CHRONOLOGY OF KSC AND KSC RELATED EVENTS FOR 1991 Annual Report, 1991
Ken Nail, Jr. Mar. 1992 281 p
(NASA-TM-107802; NAS 1.15:107802; KHR-16) Avail: NTIS HC/MF A13

A listing is given of events at or in relation to the Kennedy Space Center in 1991. A great number of the events are concerned with Space Shuttle operations. Author

N92-25413# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
DLR-NEWS: ANNOUNCEMENTS OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND ASTRONAUTICS [DLR-NACHRICHTEN: MITTEILUNGEN DER DEUTSCHEN FORSCHUNGSANTALT FUER LUFT- UND RAUMFAHRT]
Thomas H. Weyer, ed. and Helga Zimmermann, ed. Feb. 1991 52 p In GEORGIAN Original contains color illustrations
(ISSN-0937-0420) Avail: NTIS HC/MF A04

Various journal articles concerned with aeronautics, astronautics, and energy technology are presented. Some of the topics covered include: locating acoustic blade-vortex interaction sources; prediction of laminar-turbulent transition in laminar flow; an airworthy experimental system for modern navigation and reconnaissance methods; a planning system for the Frankfurt airport; rotors in wind tunnels; interdisciplinary research cooperation in aeronautics and astronautics; process control to set mach number ratios for jet-engine intake measurements; aerodynamic configuration verifications on spacecraft; and solar energy conversion efficiency. K.S.

N92-25954*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
JOHNSON SPACE CENTER RESEARCH AND TECHNOLOGY Annual Report, 1991
Apr. 1992 210 p
(NASA-TM-104747; NAS 1.15:104747) Avail: NTIS HC/MF A10

The accomplishments of JSC during FY 1991 are presented. The report serves to communicate within and outside of NASA significant R&T JSC activities and identifies principle researchers and technologists as contacts for further information. The topics are covered in five sections: life sciences, human support technology, solar system sciences, space systems technology, and space transportation technology. Each of these sections is comprised of a summary followed by detailed descriptions of significant tasks. A listing of project descriptions, along with funding code and principle investigators, is provided in the index. Author

N92-26014# Weizmann Inst. of Science, Rehovoth (Israel).
SCIENTIFIC ACTIVITIES, 1990
Peter L. Stange, ed. Mar. 1992 619 p
(ISSN-0083-7849) Avail: NTIS HC/MF A99

The Weizmann Institute of Science, a center of scientific research and graduate study, is located in the town of Rehovot on Israel's Coastal Plain. The Weizmann Institute research staff numbers some 1,357 scientists, engineers, and technicians, plus approximately 591 scientists-in-training who are pursuing their M.Sc. and Ph.D. at the Institute's Feinberg Graduate School. The Institute sponsors research activities in the following areas: applied mathematics and computer science; theoretical mathematics; physical electronics; nuclear physics; chemical physics; environmental sciences and energy research; materials research; organic chemistry; polymer research; structural chemistry; biochemistry; membrane research and biophysics; neurobiology; cell biology; chemical immunology; hormone research; molecular genetics and virology; and plant genetics. Author

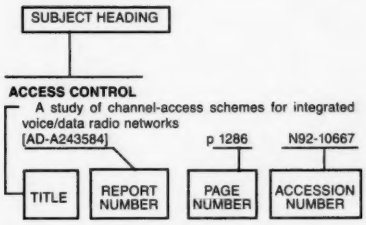
N92-26016# Lawrence Livermore National Lab., CA.
ENGINEERING RESEARCH AND DEVELOPMENT: THRUST AREA REPORT, FY 1990
Edward Lafranchi, ed., Barry Smith, ed., Paul Adye, ed., Frank Cebulski, ed., Wally Clements, ed., Mike Genin, ed., Jerry Grow, ed., Herb Highstone, ed., Kathy Kaufman, ed., and Margaret Sands, ed. et al Aug. 1991 269 p
(Contract W-7405-eng-48)
(UCRL-53868-90) Avail: NTIS HC/MF A12

The research and development activities conducted within the Engineering Research Program for 1990 at Lawrence Livermore National Laboratory are presented. The topics covered include: computational electronics and electromagnetics; computational mechanics; diagnostics and microelectronics; fabrication technology; materials science and engineering; microwave and pulsed power; nondestructive evaluation; and remote sensing, imaging, and signal engineering. H.A.

N92-26086# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
DLR-NEWS: ANNOUNCEMENTS OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND ASTRONAUTICS [DLR-NACHRICHTEN: MITTEILUNGEN DER DEUTSCHEN FORSCHUNGSANTALT FUER LUFT- UND RAUMFAHRT]
Thomas H. Weyer, ed. and Helga Zimmermann, ed. Nov. 1991 60 p In GEORGIAN Original contains color illustrations
(ISSN-0937-0420) Avail: NTIS HC/MF A04

Various articles are presented in the areas of engineering physics, physical combustion chemistry, thermodynamics, construction methods and design research, process engineering, and telecommunications. Some of the topics covered include: high performance lasers for aerospace applications; laser development; combustion products of hazardous materials; solar radiation conversion to chemical energy; development of a latent heat accumulator; continuous fiber reinforced thermoplastics; ceramic fibers; an absorption heat pump; and digital radio broadcasting.
K.S.

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The page number helps you locate the the citation in the abstract section. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus*.

A

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[NASA-CR-189909] p 2839 N92-25545

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[DE91-016655] p 2748 N92-25505

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[NASA-CR-190347] p 2733 N92-26015

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[NASA-CR-190335] p 2838 N92-25736
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ABSORPTIVITY
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[NASA-CR-190339] p 2841 N92-25280

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[NASA-CR-190361] p 2798 N92-26072

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[NASA-CR-189584] p 2813 N92-26130

ACCELERATORS
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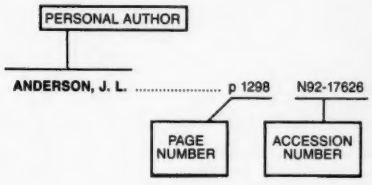

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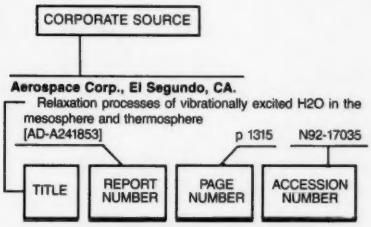

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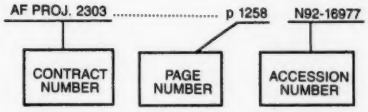

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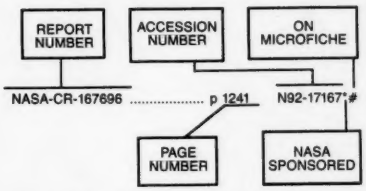

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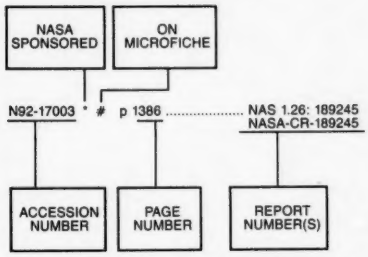

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